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Materials & Methods

THE METALWORKING INDUSTRIES' ENGINEERING MAGAZINE

VOLUME 26, NO. 2 August, 1947

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CLAD METALS FOR ENGINEERING USES
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The MATERIALS OUTLOOK...

Titanium Dioxide Very Scarce

A porcelain enamel of great promise is one in which a form of titanium appears in perhaps both the frit of the enamel and the base steel. Many porcelain enamelers are all set to use this titanium dioxide frit because it provides such marked opaqueness that only one coat of enamel is needed. However, the supply of titanium dioxide has been decidedly short for several months and a recent check shows little, if any, improvement. One producer of titanium oxide has made the discouraging statement that the porcelain enameling industry can buy only 10% of its desires in 1947. There is competition for its purchase from makers of paints, varnishes, paper, rubber, etc.

Ferrous Castings to Rise

Though one ferrous foundry has come out nobly to promise freezing of castings prices despite recent rises in coal, pig iron, scrap, coke, and freight rates, we fear this is an idle gesture with regard to castings generally. Foundrymen had already "sharpened pencils" in figuring sales prices over costs and there was not much margin left. Foundrymen, of course, realize that they have to compete with other metal forms and will pull their punches when they do lift prices.

Moly Tool Steels

The predicted advance in 18-4-1 tool steel, a tungsten, chromium, vanadium alloy, has taken place. This refocuses attention on molybdenum, which has been been unchanged for many months and promises so to continue. Now is the time to reconsider use of a 6-6-4-1 tool steel (tungsten, molybdenum, chromium, vanadium) where 6% of "moly" does the work of 12% of tungsten — and for a considerably cheaper price. It is perhaps best, too, to become better acquainted with moly steels during peace so that in case of war we are less dependent on tungsten, there being an inexhaustible supply of American molybdenum. Most of China's available tungsten is being bought by Russia.

"Hold That Tiger"—Tin

The present contract between the U. S. and Bolivia to buy the latter's tin is based on 80c per lb. When the contract expires Dec. 31, 1947 there will be pressure to raise tin prices considerably, one Bolivian-inspired argument being to raise tin "commensurate with other metals," which they claim would bring tin to $1.05. However, using metal price averages for 1922 to 1926 as a base, tin should sell at only 29c to be commensurate with its rival, aluminum, and at 94½c as regards lead, which now sells at the highest price for all time. Whereas aluminum has dropped 42%, copper has gained 54%, zinc is up 55%, tin up 61% and lead 95%. It behooves Uncle Sam to drive a sharp bargain with Bolivia, come Dec. 31. Logic is with our "Uncle."

More Variety in Beryllium Alloys

One drawback of the beryllium copper alloys is that they are expensive—a recent advance in price because of a rise in beryl ore having made them more so. However, the Beryllium Corp. is bringing out several new alloys, among them one with less tensile strength than in the original alloys, but of sufficient strength to serve in several applications. Too, what is described as a "remarkable alloy" is one of beryllium and nickel, still under development. There is good news also in the fact that whereas the refiners originally could not work with ore leaner than 10% beryllium oxide, they can now reduce profitably a much leaner ore. So, look for expanding applications of this interesting metal.

Beware Nut and Bolt Scarcities

Almost all sizes of ferrous nuts and bolts are critically scarce, though some improvement is experienced in brass lines. But the steel fastener supply is no better than a year ago due to failure to get from the steel mills sufficient tonnage of wire and rods, materials previously allocated under OPA. More and more will bolts and nuts come under black market operations, as in steel sheets. So, fabricator, better consider other types of fastenings where you can—perhaps one-piece castings or all-welded assemblies.

Silver Is a Bargain

Might as well plan to use plenty of silver for industrial purposes. It is cheap these days (61¾c as this is written). Neither monetary nor commercial uses for silver are adequate to absorb present large production. Moreover, there seems little prospect of resumption by India of large scale purchases. So, go ahead with those plans for silver brazing.

Lead Improves Gradually

Lead supplies improve gradually. A month ago consumers secured 90% of their needs; today they get 95% to 100%. Washington set aside 7,000 tons to allocate to distressed consumers in June, but they bought only half of that, indicating fair measure of satiety.

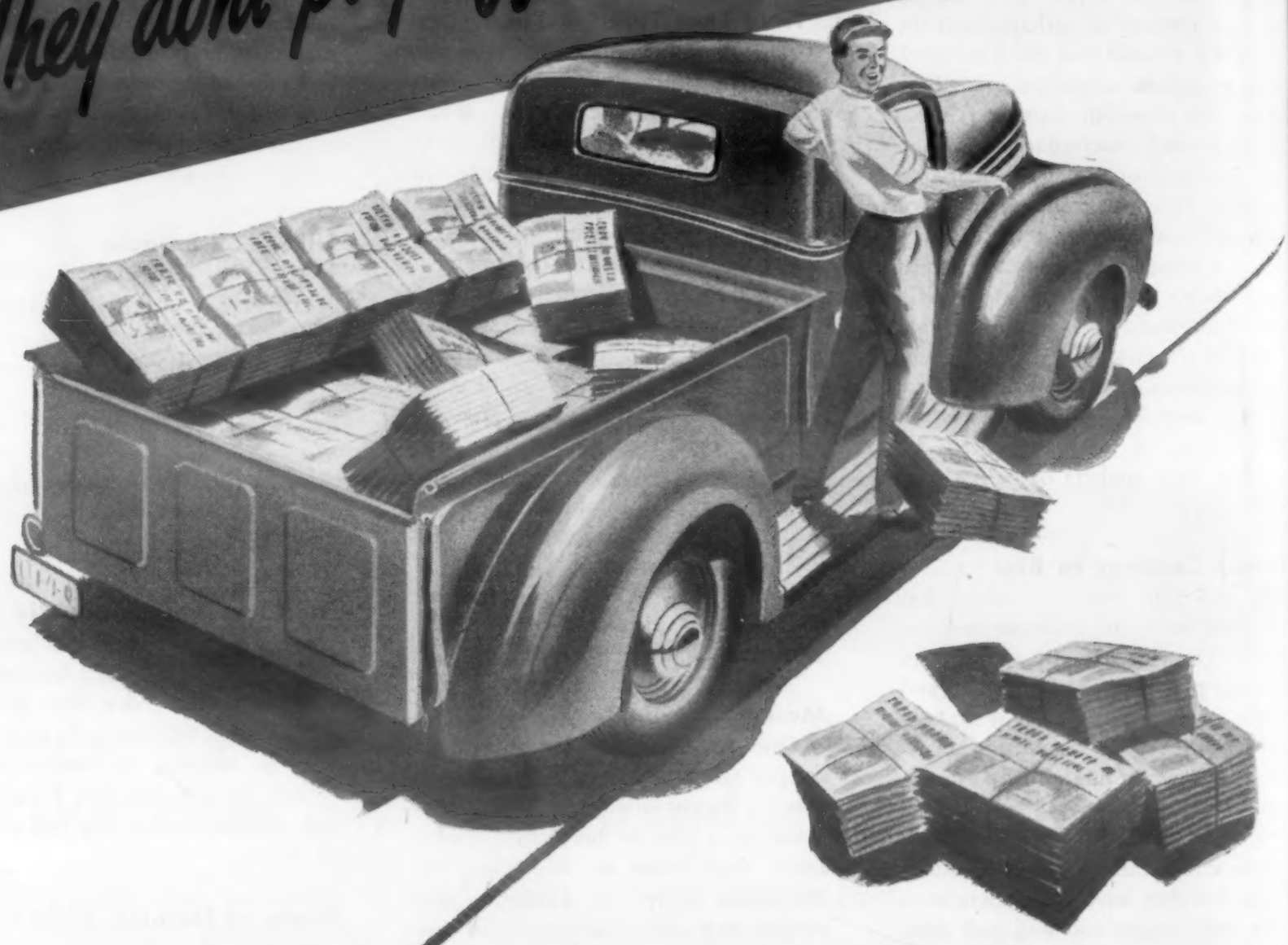
Plenty of Stainless Steel

If there is anything you could well make of stainless steel as a raw material, by all means consider it for it has become so plentiful that some go so far as to call it a drug on the market.

Better Vanadium Supplies

Users of vanadium will be encouraged to learn that receipts of domestic vanadium ore in first quarter 1947 were largest since third quarter 1945. Receipts were 63% greater than last quarter 1946, though imports were 46% less. Domestic production has gained continuously since the low point of first quarter 1946. Consumption in first quarter 1947 was 1% better than previous quarter, with continuous gain since second quarter, last year.

They don't pay off on DEADWEIGHT



When frame, body panels, fenders, wheels and other structural parts are made of N-A-X HIGH-TENSILE, a truck uses its horsepower to deliver goods, not deadweight. The high physical properties of N-A-X HIGH-TENSILE make possible weight savings up to 25% in section, yet maintain superior strength and have increased resistance to fatigue, corrosion, abrasion and denting.

On the job, the savings in pounds mean a savings in dollars. Gasoline economy is improved. Maintenance costs are reduced. Life factor is increased.

If you make a product that moves, it will move more efficiently and economically through the application of N-A-X HIGH-TENSILE. Good formability, excellent weldability and fine surface texture for finishing make N-A-X HIGH-TENSILE a great steel to work with, too.

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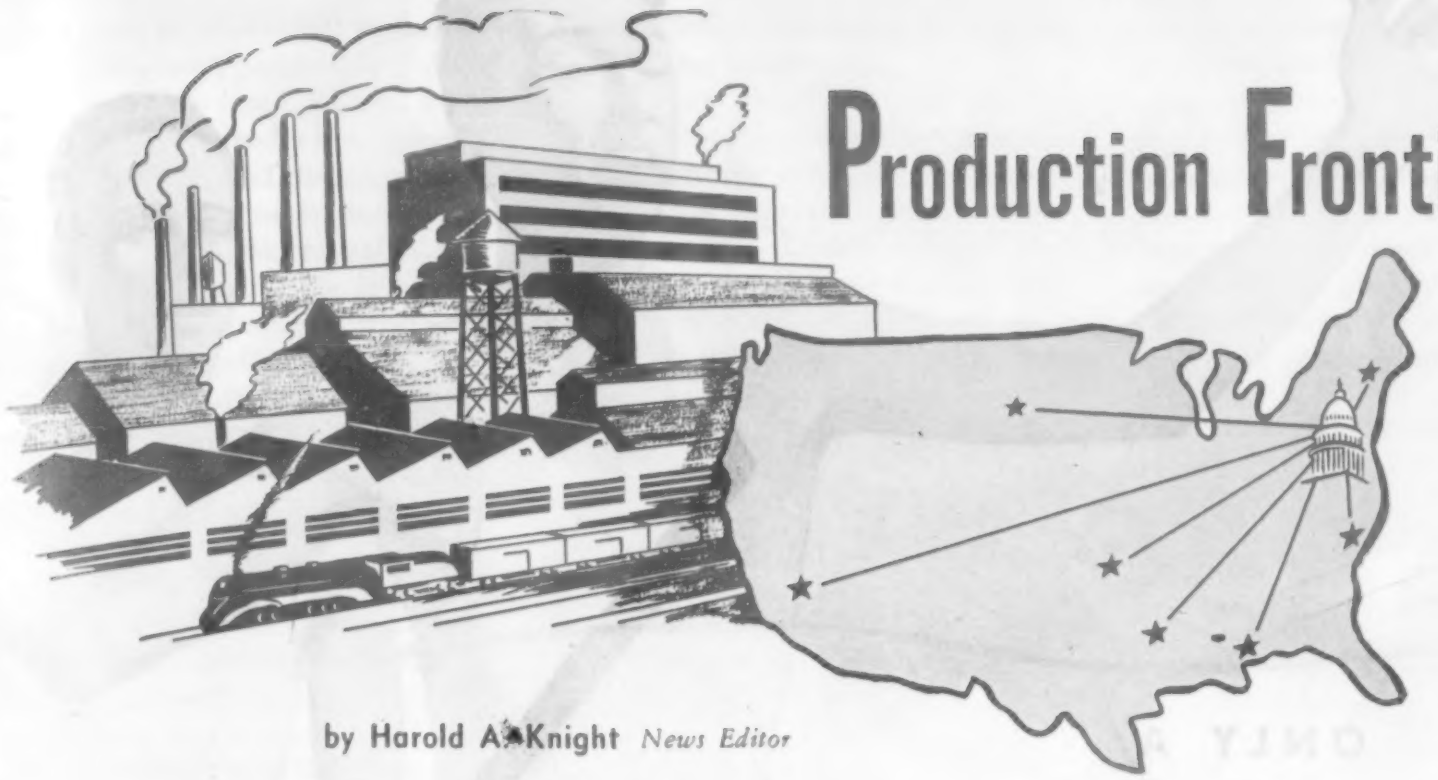

Production Frontiers

by Harold A. Knight *News Editor*

Developments in Economics, Government and Industry

During the hot summer months one tries to save his brain power, if any. It is in this spirit that we avoid too logical and orderly a presentation of "the situation," as we have learned it. Rather will we deal with "ships, shoes and sealing wax; with cabbages and kings" and just as they come out of the hopper, hopping somewhat erratically from one idea to another.

Perhaps the chief concern is the continued influence of inflation, with another series of rises in several commodities set off by the high boost to coal wages. Workers with metals may be interested to learn that statistics prove them perhaps relatively higher in price than many other commodities. Thus, the Bureau of Labor is authority for the statement, embracing the period from the March peak to May 1947, that all commodities have dropped 12.8%, but copper rose 9.5% and tin 14.3%, offset somewhat by a decline of 25.6% in steel scrap (prices of scrap have risen since). In fact, barley, cotton and corn were the only other materials to rise.

Another important theme has been tax reduction. We are already lagging behind certain other allied countries. Thus, the United Kingdom has experienced its second tax reduction and Canada has been treated to tax cuts of 29%.

On the subject of democracy and other forms of government—always a good topic where argumentative people gather—Robert R. Wason, chairman, National Assn. of Manufacturers, agreed before the American Society of Mechanical Engineers that Secretary Marshall's suggestion that the European nations get together on plans for self-aid is good. It would be equally desirable, states Mr. Wason, for the American Government to arrange for the export of the competitive enterprise system that made America, instead of the export of our products with the re-export of socialistic doctrines that may well keep the European peoples in poverty.

On much the same theme Charles E. Wilson, president, General Motors Corp., said that he is against discarding the proven efficient engine that gave the American people the highest standard of living in the world and replacing it with some imported type from Europe—similar to a jet engine, with only one spark plug—the state —and which depends for power on a blast of hot air.

Dr. Charles A. Thomas, technical director, Monsanto Chemical Co., comments on how many technical ideas have originated in Europe and then been developed by American genius. However, physical destruction and moral disruption have brought about a serious decline in science abroad. "We can no longer look to other nations for the spark which American genius can blow, tender and fan into a great fire." In short, American research must now have the sole originality and creativeness.

Many Volunteer Ideas on Industry

As to progress in industry, H. A. Toulmin, Jr., president, Hydraulic Press Mfg. Co., says that too many manufacturers are standing with one foot in the past and the other on a banana peel. They make the same old products, in the same old way, year after year. Take a tip from the automotive industry. Look at Tucker and his brand new product. Remember Ford and the utter ruthlessness with which he scrapped machines before they wore out.

Paul G. Hoffman and Raymond Rubican, Committee for Economic Development, say that small business' chief problem is management and that more failures are due to lack of skill in running the enterprise than to any other single cause. They suggest that suppliers and trade associations increase their technical aids to small business, that community organizations widen their services and that colleges set up special training courses.

The average work week in 1960 will be 37.7 hours, with two weeks' vacation with pay universal, predicts the Twentieth Century Fund. In that

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SEPARATES THE CHAMPION FROM THE REST OF THE FIELD

Contests of human speed and endurance are often decided by small margins — by split seconds.

And in stainless steel, too, it is the small differences that separate the quality metal from the "also-rans."

But these seemingly small differences are of sufficient importance to warrant careful consideration when the quality of your product and the integrity of your trademark are at stake.

Ingredients used in Sharon Stainless Strip Steel are carefully selected to exacting laboratory standards ... are precisely blended, melted and refined ... are worked by experts, by men who have devoted their lives to producing quality steel for quality products.

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SHARONSTEEL

year there will be 63,400,000 workers.

Every engineer, especially the young one, finds that "Kilroy was here" on some supposedly new invention, states D. W. McLenegan, assistant to the manager of engineering, General Electric Co., Bloomfield, N. J. However, the ideas of a young engineer should be encouraged, whether patentable or not, provided that they indicate sound analysis and original thinking, he advocated. These attempts may forerun valuable contributions eventually.

And finally, what's new in U. S. self-defense is that available mine sites have been selected for underground ordnance plants—such mines as gypsum, copper, lead, zinc, marble, salt, limestone and sandstone. Minimum requirements are 30,000 sq. ft. of floor space, a roof of 8 ft., and a reasonably level floor. We already have several hundred million square feet of available space mapped out.

Powder Metals Met Emergencies

Ever hear of nails being pressed and sintered from metal powders? Or a hexagonal nut produced, threads and all, in a single operation? Also, heating elements from iron and aluminum powders, and ceramics for home cooking and heating units?

In fact, powder metallurgy was resorted to as an emergency process in Austria during the recovery period after the recent war. Progress was impeded no end because of lack of certain minor gadgets and parts that made the whole assembly useless. Things were made of powder metallurgy that had previously not been deemed practical or even possible. What was learned in the emergency may have uncovered accepted and permanent applications in the future.

Metallwerk Plansee, Reutte, Tyrol section of Austria, was engaged in manufacture of many ordnance items during the war. The end of the war left Reutte without a working program, without customers and without financial support. The story is told by Dr. Paul Schwarzkopf, president and director of research, American Electro Metal Corp., and published in *Powder Metallurgy Bulletin* for May.

The machinery and staff of engineers and skilled workers had remained unimpaired throughout the war. Finally, the personnel loaned their savings and earnings to the management. Luckily there was an availability of powders at the time of lack of bar metal stock.

Without the Metallwerk Plansee the electrified Austrian railways would not be running today. Burnt-out commutators of generators were replaced from powders. Carbon brushes, previously imported from France, were of minus quantity, hence Reutte produced carbon brushes by sintering.

"I'll be late, dear! I'm working on a new shape!"

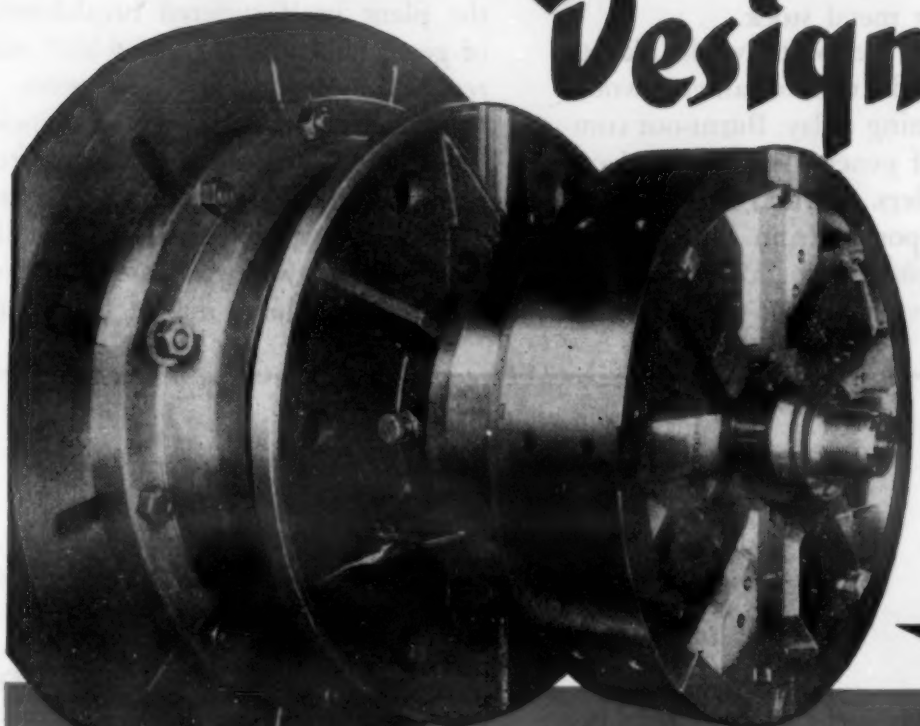
Left without coal, electric power became more important and many household functions depended on electric heating and cooking utensils, and here powder metallurgy came to the fore. The close relation between powder metallurgy and ceramics was demonstrated by forming these ceramics in the presses and furnaces used by the p.m. techniques.

Reutte produced pressed and sintered key blanks, latches and lock boxes. Remarkable skill was revealed in the manufacture of varied machine parts and household appliances. Often the plant itself suffered breakdowns of gears, shafts, etc., all of which was replaced by its own special process.

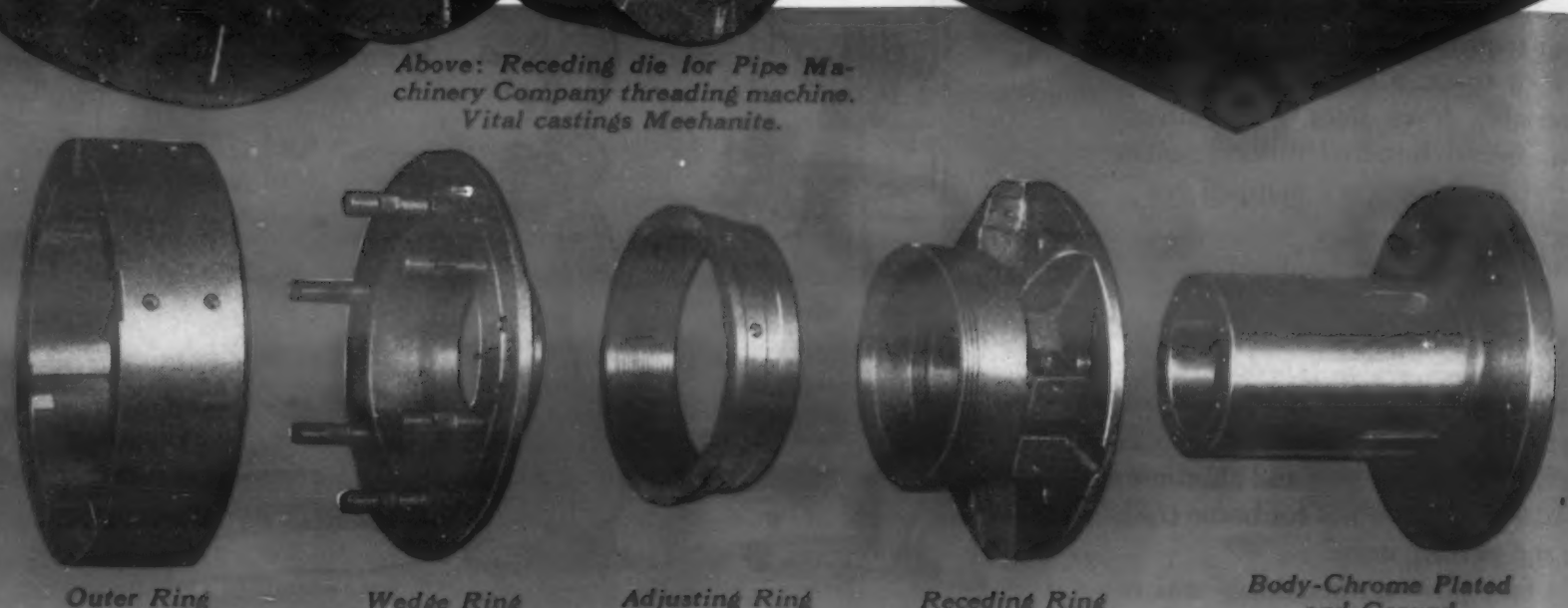
Assemblies of magnets and pole shoes, pressed simultaneously, represent a new development which may be adopted in the United States. This method does away with assembling of separately produced magnets and pole shoes and eliminates clamping, riveting and soldering. Reutte presses layers of powders of magnet and pole shoe material, then sinters these composite compacts in a single operation Sintered bimetals on iron-nickel base and sintered diamond-embedded alloys, pressed and sintered from diamond, iron and copper powders, are further examples.

Take the hexagonal nut mentioned in the opening paragraph. Sintered nuts can be impregnated with oil and low-melting metals. They are more

Designed to be better with MEEHANITE® CASTINGS



Above: Receding die for Pipe Machinery Company threading machine. Vital castings Meehanite.



Outer Ring — *Wedge Ring* — *Adjusting Ring* — *Receding Ring* — *Body-Chrome Plated and Ground*

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The American Laundry Machinery Co.	Rochester, New York
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The Stearns-Roger Manufacturing Co.	Denver, Colorado
Traylor Engineering & Mfg. Co.	Allentown, Pennsylvania
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Only quality, high precision machinery is produced by The Pipe Machinery Company, Cleveland, Ohio. Outstanding in their line is pipe threading equipment producing API quality threads.

Illustrated is a receding chaser die for pipe threading and the five *important* Meehanite Castings embodied in its construction.

Note that the body casting is chrome-plated and ground, to extremely close tolerances. All these Meehanite Castings are produced in Type GA Meehanite providing a minimum tensile strength of 50,000 psi (1.2" diameter test bar), uniformly solid, dense and machinable castings, which maintain their original accuracy permanently.

When analyzing the component parts of your equipment be sure you are acquainted with the superior properties and high quality which can be built into it with Meehanite Castings.

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corrosion-resistant than machined nuts and have no tendency to rust or stick.

"Science and Imagination"

The war made Americans conscious of the importance of industrial research which went a long way towards bringing victory. That spectacular winner of wars, the atomic bomb, was the direct product of research. There develops, too, a new concept of research. The researcher must not depend too closely on old formulas and concepts. Remember that trite example of early aeronautical engineers who could prove on paper that the bumble bee cannot fly. A host of successful researchers rudely knocked over old rules and concepts—such men as "Boss" Kettering who, for instance, designed a radically new cylinder for a Diesel engine along lines previous experts had said were impossible.

Retiring veteran researchers are passing along to younger generations some new basic principles, chief among which is to take nothing for granted that appears in the text books and handbooks.

Much along these lines was a recent talk by Dr. J. R. Van Pelt, educational director, Battelle Memorial Institute. Making the statement that research and development may eventually employ as many new engineering graduates as the combined fields of production, sales and management, Dr. Van Pelt proceeds to lay down some principles for the training of these engineers.

There is a growing emphasis, says Dr. Van Pelt, on mastery of scientific fundamentals. In the research laboratory, the engineer with incomplete knowledge of fundamentals is severely handicapped; no "handbook engineers" need apply. Research organizations are constantly seeking men who combine originality of outlook with rigorous scientific knowledge.

"Brilliant research is the offspring of that happy pair, science and imagination. Some of the greatest leaders in research, appraising the qualities that have contributed to success in research, have placed unquenchable optimism, freedom from restraint, and uninhibited imagination far above technical knowledge. Formal education has been excoriated for its tendency to deaden these precious virtues and to substitute nothing better than dull data. The charge is only partly proved, but there is enough truth in it to hurt. It is along the frontiers of knowledge, not in the well-traveled interior, that adventure is to be found. There the imagination can take wing; there the rewards of intellectual courage are greatest."

Research engineers need to be expert observers and to be on the alert for those inconspicuous departures from the expected which have led to many a discovery, the speaker said. In commenting on the engineer's need for a good command of English, he said: "Take the case where an engineer must convince nontechnical management that it should change a manufacturing process, use a new material or introduce a new product. It is not sufficient that the nontechnical report should be correct; it must also be convincing. To be convincing the language must be thoroughly understandable and, if possible, attractive. Such requires thorough training in nontechnical English."

Too Little—Not Too Late

We are indebted to "Private Wire," house organ of the American Brake Shoe Co., for what they call an "engineering thriller." It is a story of the construction of the Salmon River Bridge in Alaska.

The steepness of the river banks required that this bridge be of cantilever type. The two ends were built out from the opposite shores, to be joined in the center by a final heavy truss. Since this river freezes in winter to a depth of 60 ft., the engineers placed a trestlework of wood on the ice to support the two bridge-ends, confident of completing the structure before the spring thaws.

The two wings, of immense weight, were extended over the icebound torrent until they almost joined; and the central truss was then dragged up. To their horror, instead of being the 16 ft., it was but 14 ft. long. The specifications engineer, in drafting his order, had failed to close a vital numeral. Spring was fast approaching. More than a million dollars had gone into the bridge.

Imploring cables burned the wires to the firm in Pittsburgh which had made the central truss. Extra gangs of men labored continuously at the steel mill until a new structure was thrown in the flat-cars, and hurried at express speed to Seattle. Gangs of men frenziedly hurled the truss aboard a vessel. At the Alaska terminal new gangs still more frenziedly unloaded it on a waiting train. That train was whisked to the banks of the Salmon River. Here more frantic men, toiling like demons, lifted the truss to the center of the structure and fiercely bolted it into place. Forty minutes later the ice went out!

Please, Mister—An Imitation!

Ordinarily we do not wish to stop the trend of modernity. But we at least gulped with something akin to dismay when we learned that a foresighted manufacturer is building the old-fashioned outhouse of aluminum. Somehow that isn't quite cricket, as the English would say.

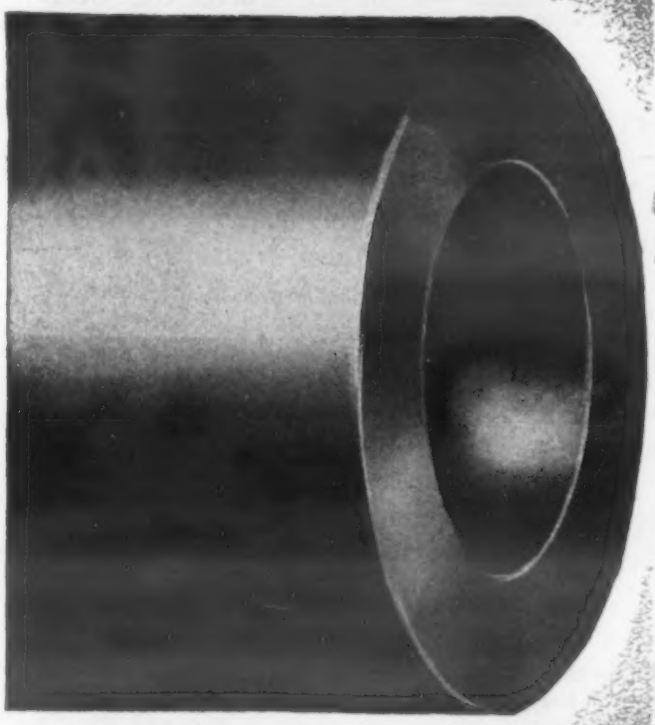
An outhouse, as so many of us remember with nostalgia, is a place of retreat—a haven where the overburdened head of a boisterous household could snatch a few moments of solitude and surcease from care. It was a place, too, where adolescent Willie, recently graduated from the child's lower seat to the adult bench, could try out those dried corn silks in his clandestine corn cob pipe, away from prying eyes of parents.

The aristocratic outhouse of yore had cooling ivy or morning glory growing up its walls. Will not these plants be allergic to aluminum? Even the wooden walls themselves, mellowed by wind and sun, had a sweet musty old smell, like the keg in which whiskey has aged through the years. The wasp or bumblebee built a nest under the eaves and buzzed away the hot days of midsummer. Will he build under aluminum eaves?

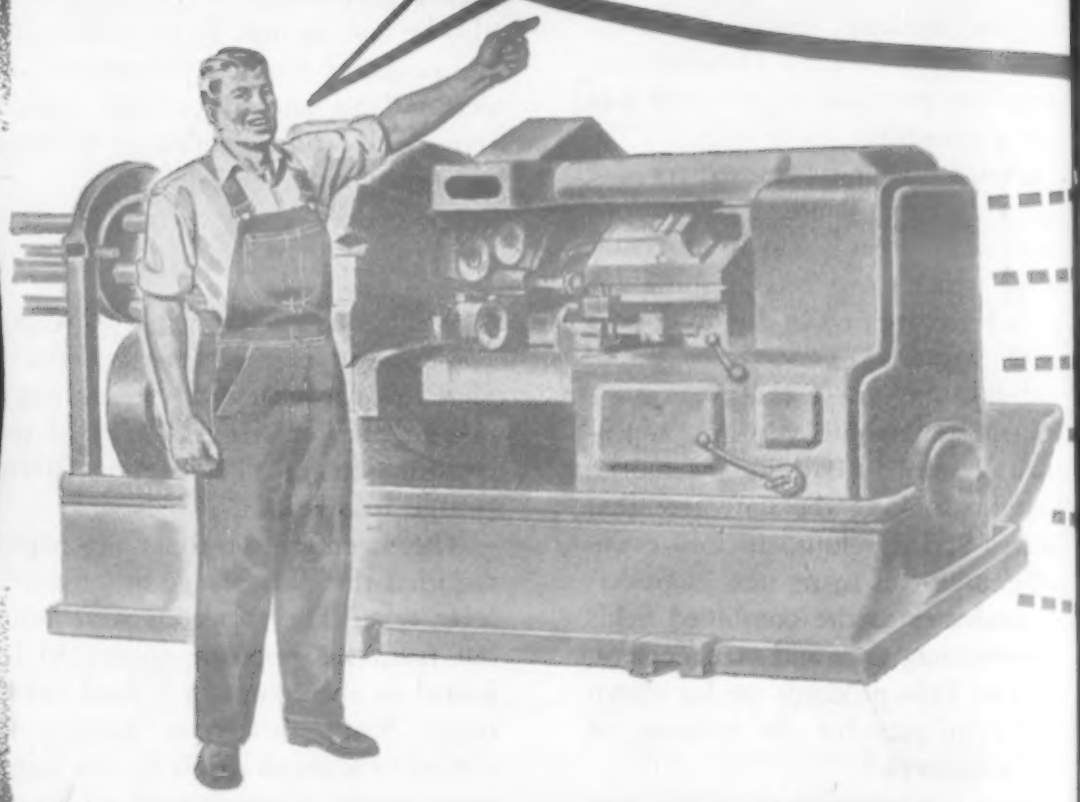
Finally, come Halloween: How easy it will be for the village roughnecks to tip over the light aluminum number, usually with protesting grandpappy inside!

However, we are willing to make one concession in the interest of progress. Let it be made of aluminum. But that metal is so versatile that it will take an infinite number of finishes. Let it, therefore, resemble the old-fashioned little building, with imitation planks comprising the walls running up and down. Let it have the crescent-shaped windows and imitation cedar shingles, some of them a bit askew. Even paint in a wasp's nest under the eaves.

And when it's finished we'll stand off ten paces and view it critically. We've compromised, but the nostalgic lump will not down from our throat.



THEY COME 60% TO 100% Rockrite



New, even startling, possibilities in screw-machine output of cylindrical and ring-shaped parts have been opened up through the use of Rockrite Tubing. In one case, two parts were finished simultaneously from Rockrite Tubing whereas only one could be made at a time from ordinary mechanical tubing. The output of parts per machine hour in other cases has been raised 60 per cent . . . even 100 per cent.

Rockrite Close Tolerance Tubing is more concentric than commercial tubing, has less variation in wall thickness, and is sized to closer outside- and inside-diameter tolerances. Lighter, faster, more uniform cuts are made possible, permitting practical use of forming tools with longer tool life, and other advantages.

In many instances slow boring can be eliminated as a bottle-neck to production. Fewer machining operations are required, and frequently stations can be released for added operations.

AN EDITORIAL

Materials and Horses

"You can lead a horse to water but you can't make him drink" is a bromide that applies to the materials problem faced by many plant engineers and operating men today. As they see it, some budding genius in a technical ivory tower writes into a product-manufacturing specification the type of material to be used and from that time on, cracks, burrs, broken tools and bulges are the order of the day until somebody has the practical wit to change the material or adapt the manufacturing procedure to the original material. You can write a given material into a specification but you can't necessarily make it form, draw, machine, weld or harden as intended, by that act alone.

Plant men repeatedly tell us, often with tears streaming down their rugged cheeks, "Materials are the biggest headache we have. Not just procuring them, but fitting specified materials into our manufacturing operations . . . making cups on a draw-press out of material that can't take the draw without cracking . . . hitting 62 Rockwell C with a big steel part when the material some (censored) so-and-so specified hasn't enough hardenability . . . trying to make a threaded part at a price out of an alloy that machines like cement . . . or rubber . . . making valve castings out of a fine new corrosion-resistant material and then finding they leak like a sieve no matter how we cast them . . . weld-cracks, hard spots, broken dies, blushed lacquers, loose electroplates, gray hairs, ulcers! And you ask if we have *materials* problems . . . what other kinds of problems *are* there?"

We can readily see why this leaves the plant man with the same feeling toward specification writers and materials engineers that Marshall has for Molotov. The solution is simple (correction: it is simple to state): The engineers who specify materials must know how these materials will work in the plant, and the men in the plants must know how to work the materials specified. When either of these conditions is lacking peace and efficiency disappear.

Attention to the working behavior of specific materials is a major feature of this magazine's editorial program. We recommend it to those who have led the horse to water but can't make him drink.

FRED P. PETERS

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Have you considered stainless steel for every application where its corrosion resistance, everlasting brightness and long life will save money or increase the sale of your product? You can easily try it because Ryerson stocks of Allegheny stainless are as near as your telephone and we're just as pleased to furnish a single piece for experimental work as a large shipment for quantity production.

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RYERSON STEEL

EDITORIAL COMMENT

Materials and Our Merchant Marine

The announcement that approval d been given of the designs for a ew type of merchant ship was made Aluminum Company of America st fall. The ship, of just under 15,000 ns, provides the cargo capacity and any convenience features of a vessel 17,000 tons by liberal use of alumi- um in the superstructure, bulkheads, nd interior fittings. In May the first these new ships slid quietly out of ew York upon her maiden voyage to e Caribbean. She appears to have ved up to expectations, and two sister ips are to be built for Alcoa Steam- ip Co.

American ingenuity must produce a iracle if our merchant marine is to be ept on the high seas. We can build e ships—we did it by the thousands uring the war—but we can't operate em competitively. The facts point p a theme often twisted by various rganized groups seeking something extra for themselves—that our high standard of living is the result of the increased productivity of capital, guided by our mass production en- gineers, rather than the so-called "in- creased productivity of labor." Our wage standard is the highest in the world, not because our workers are super-skilled, but because the largest investment of capital per worker has placed in their hands the best tools in the world.

As soon as we step out of those lines in which mass production tech- niques can support this high wage scale, the wage scale can be supported only by levying a contribution upon the American taxpayer. This is the case in international shipping. Costs are largely labor, with no possibility of increasing the efficiency of that labor by increased capital investment. The American merchant seaman has de- manded, and received, the highest wage in the world for such labor. Now we discover that the shipowners can stay in business, in direct competition with lower-wage merchantmen, only with the aid of government subsidies, direct or indirect, or by obtaining special consideration from the government upon docking or cargo handling at our own ports.

With operating costs about twice those of comparable British ships be- fore the war, the American merchant flag was rapidly disappearing from the high seas. The British, in turn, were being squeezed by the Norwegians, with a still lower wage standard. Where wages determine costs, and costs de- termine ocean freight rates, it can be clearly understood why the American merchant marine steadily declined in size, Britain just about held her own, and Norway, third in tonnage, in- creased.

A Navy officer, formerly in the mer- chant marine, put the story in figures. "When I was a third officer, in 1925, I received $140 per month. A messboy at sea now, with overtime and bonuses, gets about $250."

Perhaps American engineers, using new materials, can produce a super-ship that will do for the merchant marine what the mass production engineers have done for the worker—increase his efficiency so greatly that the world's highest wage scale can be supported. Left to themselves, without the ham- pering effect of Government or union edicts as to the size of crews, they cer- tainly could. But under the circum- stances it seems doubtful.

—K. R.

Yardstick on Steel

Suppose we take a brief refresher course on the United States steel in- dustry—its capacity to produce and actual performance so far, since to be well informed about materials one should have some up-to-date facts about the production of this, our most basic material. The facts are largely those of Walter S. Tower, president, Ameri- can Iron & Steel Institute, reporting to the Senate Subcommittee for Small Business.

Our 233 blast furnaces have a rated annual capacity of nearly 66,000,000 tons of pig iron, after deducting 10% time off for repairs. The 1170 steel- making furnaces can produce 92,000,- 000 tons of steel ingots, deducting 12½%. In September 1939, these capacities were respectively 56,000,000 and 82,000,000 tons—a year in which the industry was criticized for over- expansion.

Based on ingot production for the first half year, the 1947 output will be 84,000,000 tons, or 20,000,000 tons over any peacetime tonnage which this country has been able to consume.

It looks as though the 1947 operating rate will be over 90%, the closest ap- proach in peace having been 88.5% in 1929 when 61,435,000 tons were produced. Another important point, often overlooked, is that any specified steel tonnage goes farther today than in 1929 because of the tendency to use lighter steels, both carbon and alloy.

Because of the metallurgically un- sound and therefore discarded portion of each ingot, the yield is 73%, which implies a 1947 production of finished steel of 62,000,000 tons, 15,000,000 tons above any previous peacetime need. For the first half of 1947, 31,000,000 tons were shipped to con- sumers, the average tonnage for an *entire year* between the two world wars.

A chief aggravation is that steel scrap, an important raw material for making steel ingots and castings, has been scarce since 1940 and what scrap is used is poorer than standard. (See editorial: "Plea for More Pig Iron," MATERIALS & METHODS, for April, 1947.)

Mr. Tower concludes that present capacities, plus new capacity being completed, should meet every expect- able demand in the near future. To which we add our own observation that expansion of capacity over the past decade is commensurate with expan- sions in all other decades of this cen- tury.

—H. A. K.

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Materials & Methods
THE METALWORKING INDUSTRIES' ENGINEERING MAGAZINE
AUGUST 1947

The petrographic microscope aids in the development of economic methods of utilizing low grade iron ores. (All illustrations courtesy: Battelle Memorial Institute.)

Steel Research Helps Meet Needs of Industry

by **CHARLES M. PARKER,** *Secretary, Committee on Manufacturing Problems, American Iron & Steel Institute*

Research teams in the steel industry strive constantly to meet the needs of steel users, improve steelmaking practice, preserve natural resources, and find substitutes for highly alloyed steels. An example of the results of efforts of this nature is the development of free-machining stainless steel.

RESEARCH IN THE STEEL INDUSTRY falls into three main categories: product research, process research, and fundamental or pure research. The three categories are closely related by their common objective of producing the best possible product at the lowest possible cost.

The entire steel industry has a part in this ever-progressing research. The process operating data and the records of orders received by the mills are under constant study to detect the various trends that may be revealed by this mass data. Such studies point out the various specific problems that should be investigated to maintain the position of steel as one of the keystones of our industrial economy.

Successful solution of these specific problems in

Small scale pilot plant equipment is used to develop methods of producing new, high-alloy steels.

either the development of new products or in improved processes result in better quality or lower cost in the multitude of products in which steel is a vital part. Most efficient solution of these problems is obtained when investigations are carried out by specially trained teams of research workers. Although the independent researcher has a definite place in steel research, the research team offers greater possibilities of ultimate success in the solution of any given problem.

Free-Machining Stainless Steels

An excellent example of team work is the development of free-machining stainless steel. For many years sulfur had been added to steel to improve its machining qualities. When added to steel containing large quantities of nickel, as in some stainless steels, the nickel and sulfur formed an undesirable compound that made the steel "hot-short" or brittle. This condition caused great difficulty in rolling and produced a steel that had poor surface characteristics. Attempts were made to modify the effect of nickel in the presence of high sulfur contents, but the resulting steels had other undesirable features.

To solve the problem, the characteristics of all elements which seemed to hold promise were studied. Ten elements were selected for experimental work and many sample heats were made and processed. Some of the ten were rejected because they had harmful physiological effects on the workman. Some were rejected because of commercial unavailability.

Finally, the element selenium was found to have the desired characteristics and work on it was intensified. A program was laid out which was designed to reveal all the facts, and upon its conclusion the optimum combination was known. It was found that stainless steel containing selenium exhibited not only the desired superior machining qualities, but that it rolled well and had greater structural toughness than similar steels containing high sulfur contents.

As a result of that work, free machining stainless steel was widely adopted for dental, surgical and food handling equipment, thus enhancing gracious and sanitary living.

Blast Furnace Developments

The blast furnace has benefited by the activities of research teams both in the solution of specific operating problems and in extension of the type of ones that can be economically reduced. One such instance occurred not long ago, when a couple of blast furnaces started to misbehave and a research team of scientific detectives tracked down and eliminated the cause.

The magnetite ores of eastern New Jersey, al-

though high in iron content, are difficult to smelt. One plant, which operated chiefly on those ores, had installed a concentrating plant in which the ores were ground fine, washed and sintered. In spite of such careful treatment, the furnaces were consuming from 1700 to 1900 lb. of coke per ton of iron produced. The theoretical consumption should be about 1400 lb., a figure that many other blast furnaces approached. It was noted that the furnaces were producing too much carbon monoxide and not enough carbon dioxide, a fact which indicated that coke was being burned without reducing iron.

Changes in sinter size and burdening practice were made in an effort to correct those conditions, but to no avail. In the meantime, other members of the research team were busily reviewing every bit of pertinent literature in an effort to find a clue to the solution of their problem. Finally, a publication of the United States Bureau of Mines suggested a solution.

After careful consideration, a bold plan was adopted. A blast furnace was frozen, that is, permitted to cool down without any effort being made to empty it. By doing this it would be possible to examine the reaction products from every position of the furnace and to secure data as to actual conditions prevailing during operation.

Samples were taken from key locations in the furnace and painstakingly examined under the petrographic microscope—and the problem was solved. It was found that in one of the furnace areas, where substantial reduction of ore should take place, the ore became impermeable because the sinter was fusing, forming superheated ferrous silicate which liquified and dropped through the furnace burden to cooler areas. There it solidified, enveloping the colder sinter particles, thus preventing previously formed carbon monoxide from penetrating to the ore.

Practice at the concentrating and sintering plant was changed to produce sinter containing 4 to 6% silica instead of the 12% previously contained, and the blast furnaces rapidly became normal, using only 1467 lb. of coke per ton of iron, a close approach to the theoretical figure.

By such attacks, research workers of the industry will eventually develop methods for the reduction of the taconites of the Lake Superior region and free America from concern for her iron ore resources for more than a thousand years. The work is already well under way and "laboratory success" has been achieved. In the normal course of events commercial success will follow in relatively few years and scientific research will have given America insurance of its continued industrial greatness. It is interesting to note that 50 years ago the ores of the Mesabi range were considered worthless. The Mesabi has shipped some 67% of all Lake Superior ores since 1915—a triumph of research.

From time to time, economists or politicians or both, seek to enter the fields of science or engineering —generally with disastrous results because they do not have the necessary rigorous training and they lack appreciation of the interrelationship between technology and economics. One of the most notable of such excursions was the effort of those who wanted the steel industry to abandon blast furnaces and produce its steelmaking iron by the sponge iron process, a process which has never been commercially successful on a large scale in any country of the world —and that in the midst of the most terrible war in history.

A sponge iron plant was contracted for and construction started. It was found to be not possible to build a plant for the amount of money allotted, this, in spite of the fact that its proponents believed the money allotted to be too generous, and after three years of diligent effort the plant had not produced more than a few tons of usable product. During that three years our blast furnaces produced about 150,000,000 tons of good, old-fashioned iron.

The fact that it is not possible to separate technology and economics was completely overlooked by the proponents of sponge iron. Technically, the process can be made to work and some day perhaps small sponge iron units may find a definite place in our economy. Even though technically the process should become sufficiently successful to displace the blast furnace as a source of metallic iron, it can never displace the blast furnace as one of the most import-

The development of new alloys requires investigation into all phases of their production and use.

ant economic units in our whole economy.

A blast furnace needs coke ovens to support it, and from the by-product coke ovens come so many coal chemicals needed by industry and by medicine that even in the absence of blast furnaces to consume the coke produced it would be necessary to operate by-product coke ovens, because the chemistry of synthesis has not yet caught up with the ability of the coke oven to produce essential commodities.

When it does, and when the sponge iron process becomes as efficient both metallurgically and costwise as the blast furnace, we may then be ready for a change. That change may be delayed, however, because it seems inevitable that some time in the future the steel industry of the United States will have discovered how to produce oxygen at a cost which will permit of its use in blast furnaces. Technically, the success of an oxygen-enriched blast is proved, although the mechanical and physical details of commercial use have not been perfected. Its use promises greater yields and lower fuel consumption than exhibited by presently operated equipment, but accurate accountings have not been made and real costs are still unknown.

Operating blast furnaces under pressure holds high promise, too. One furnace has been so operated in the United States for a period of about two years. Incomplete and informal reports tell of its success, and complete details are promised for the near future.

There is a school of thought which leans toward the will-o-the-wisp known as direct reduction, that is, the direct production of steel from iron ore without benefit of blast furnace or steelmaking furnace as we know them today. It is one of those "perfect" processes which, even if successfully developed, could revolutionize our economy. Economic success for such a process seems quite remote since technical success has not been approached.

Open Hearth Developments

In the field of open hearth steelmaking much work has been done and much is under way. The most important reaction in the open hearth is that which takes place between carbon and oxygen, yet there is no general agreement as to the exact nature of the reaction.

The open hearth flame has been enriched with oxygen in an attempt to speed the reactions of the process. These experiments have been generally successful. But it is known that the chemical reactions in the liquid metal can go faster than the reacting materials can be brought together under presently used methods. Slag fluidity and bath agitation are also important factors in speed of reaction.

For that reason a new research approach is being made which involves bubbling oxygen through the liquid metal. Many mechanical as well as chemical problems are involved in that approach but the work is being pushed forward diligently. Success will pay high dividends. Other problems of the open hearth now under study are sulfur removal and the equilibrium relationship of manganese and chromium between slag and metal.

The use of gases in steelmaking is not confined to oxygen; nitrogen is used successfully as an alloying element in stainless steel and argon is being used in electric furnace practice to improve the internal condition of ingots. Those developments were the result of imaginative yet painstaking research.

But the principal problems of the future will probably revolve around the production of alloy steels to meet the needs of the new technology which is inevitably growing out of our war time experiences. Those problems will involve both the procurement and proper use of alloying elements, some of which are almost becoming commercial rarities.

Advances in fundamental knowledge makes it possible to predict the behavior of steel in quenching.

The blast furnace, the keystone of the steel industry, is under constant study in search of improvements.

All over the world we are now working on the best of our ore reserves. At the present time to secure 1 lb. of nickel we must mine and work 55 lb. of ore. To secure 1 lb. of tungsten we must mine and work 94 lb. of ore. The second grade reserves in the United States are such that, in the future, it will be necessary to mine and work 252 lb. of ore to secure 1 lb. of metallic tungsten.

The grades of manganese ore which we are able to import reduce our work to 2 lb. of ore for each pound of manganese. Manganese-bearing ores in the United States require 7 lb. of ore for each pound of metallic manganese secured. Unless new reserves of many elements are uncovered, new economical techniques of extraction will have to be devised or steel compositions leaner in essential alloying elements will have to be used. The recovery of "lost" vanadium from slag is an excellent example of the success of such techniques, many more of which are under active study.

Some of our problems may well be solved by atomic energy, but at this time it does not seem necessary to split the iron atom to discover its secrets. To the scientists of the future it may, however, become a life and death problem if they are to have the manganese and chromium, which are among the reaction products of fissioned iron, necessary to their operations.

We shall, however, find it necessary to explore the actions of iron atoms under various conditions of environment, and that study may bring into being the use of elements now little known or appreciated. Such a trend already exists.

Beryllium has been used successfully in manufacturing a stainless steel which achieves its maximum strength and hardness at about 1300 F. Boron, germanium and tellurium have found use as agents which increase the ability of steel to harden. Selenium is in common use as an alloy in free-cutting steels. There are many other elements similar in nature to those cited that may have important effects upon the behavior of the iron atom. Those elements will be explored.

It is reported that the Russians have produced steel having a modulus of elasticity of 40,000,000 psi. That is one-third higher than the modulus of any commercial steel that we know today. The implications of such a development, coupled with the abilities which engineers have developed to utilize elevated temperatures and pressures in jet propulsion, are enormous.

If the report is true it means that, in light of our present understanding, the age of nonferrous light metals is pushed many, many years into the future, unless, of course, some brilliant metallurgist succeeds in alloying magnesium in such a fashion that its modulus of elasticity raised to many times the 6,000,000 psi. to which it now is limited.

Developments in Ingots

But before some of those problems having such broad political implications are solved, the industry must solve some lesser ones, problems which are of great importance both to the producers and consumers of steel. Even the best ingot has slight irregularities which must be removed from the steel. Some of them are internal, and those are eliminated by cropping or discarding a certain percentage of the upper portion of the ingot. Other defects are on the surface and must be removed by chipping or scarfing. The latter type of irregularity would seem to be the easier of the two to eliminate. There is work being done with that in mind, and should it become possible to produce an ingot having a surface of such excellence that surface conditioning were eliminated it would mean a saving of some $200,000,000 a year to the steel industry, with probable proportionate savings to the steel consumer.

One of the obvious ways of eliminating such troubles is, of course, eliminating the ingot. Some operating executives of the industry today express the belief that, by the time another steel generation passes, the ingot phase in steel production will have been eliminated.

Much work has been done on this problem in the past, especially in respect to direct rolling of molten

steel. It appears that one of the major weaknesses in the processes suggested was the materials against which the liquid metal was cast. There has been no metal available which could withstand the heat and erosive action of liquid steel. The metals being produced to assist in solving the problems of jet propulsion may well assist in solving the problem of eliminating the ingot.

Moreover, there are many mechanical problems of a precision nature to be solved before success is achieved. But once again, the stakes are high because theory tells us that steels having a grain size of a fineness now unattainable with all their attendant advantages may be possible.

High Temperature Problems

But before this can be done it appears that we must develop refractories that will enable us to make use of the maximum temperatures which the electric furnace has within its ability to place at our disposal. Up to now our limit of about 3500 F is imposed by the refractories, not by other elements of the process.

That in turn leads to another problem in measuring the temperature of liquid steel. Many devices have been invented in the past few years to do that, but these devices do not work equally well under all conditions and, even under conditions for which they were especially devised, they have limitations.

The complex interrelationships among alloys in their phase systems is in some cases peculiarly responsive to rather minor changes in temperature. Until we can measure temperature with sufficient precision to know that we are within those narrow ranges our work on the complex heat resistant alloys will be something less than perfect.

Indeed, until we can measure such temperatures accurately it will not be possible for us to examine completely the phase systems of some alloys which are in common use. The iron-carbon-nickel and the iron-nickel-chromium systems have not been too well defined even though millions of tons of those alloys have been used successfully. We are entering an era in which more complex relationships such as cobalt-columbium-titanium are becoming of prime importance both commercially and militarily.

As engineers extend farther the limits of temperature and pressure which they can utilize in their skillfully conceived engines the thermodynamic properties of steel assume new importance. Yet it is only for pure iron that we have knowledge of such things as specific heat, heat content, entropy, and free energy.

Fundamental Advances

It is not strange that many of these problems now emerge as persistent ones at just about the time that metallurgy is emerging as a science rather than an art. Accepted definitions of a science always include the element of predictability. Generally speaking, predictability is based upon mathematics and the theory of probability. It is only within the last five or six years that it has been possible to use a mathematical approach to a steel composition and predict with any degree of accuracy what that steel might do in heat treatment and in ultimate use. The invention of those tools has already made serious changes in our ideas relative to alloys, and this science is still in its infancy.

Within that short time we have seen the iron carbon diagram of Roozeboom and Sauveur replaced by the so-called S-curve of Davenport and Bain, and we have seen the phase rule of Willard Gibbs, which so long lay dormant, rise to a preeminent position in chemical and metallurgical calculations.

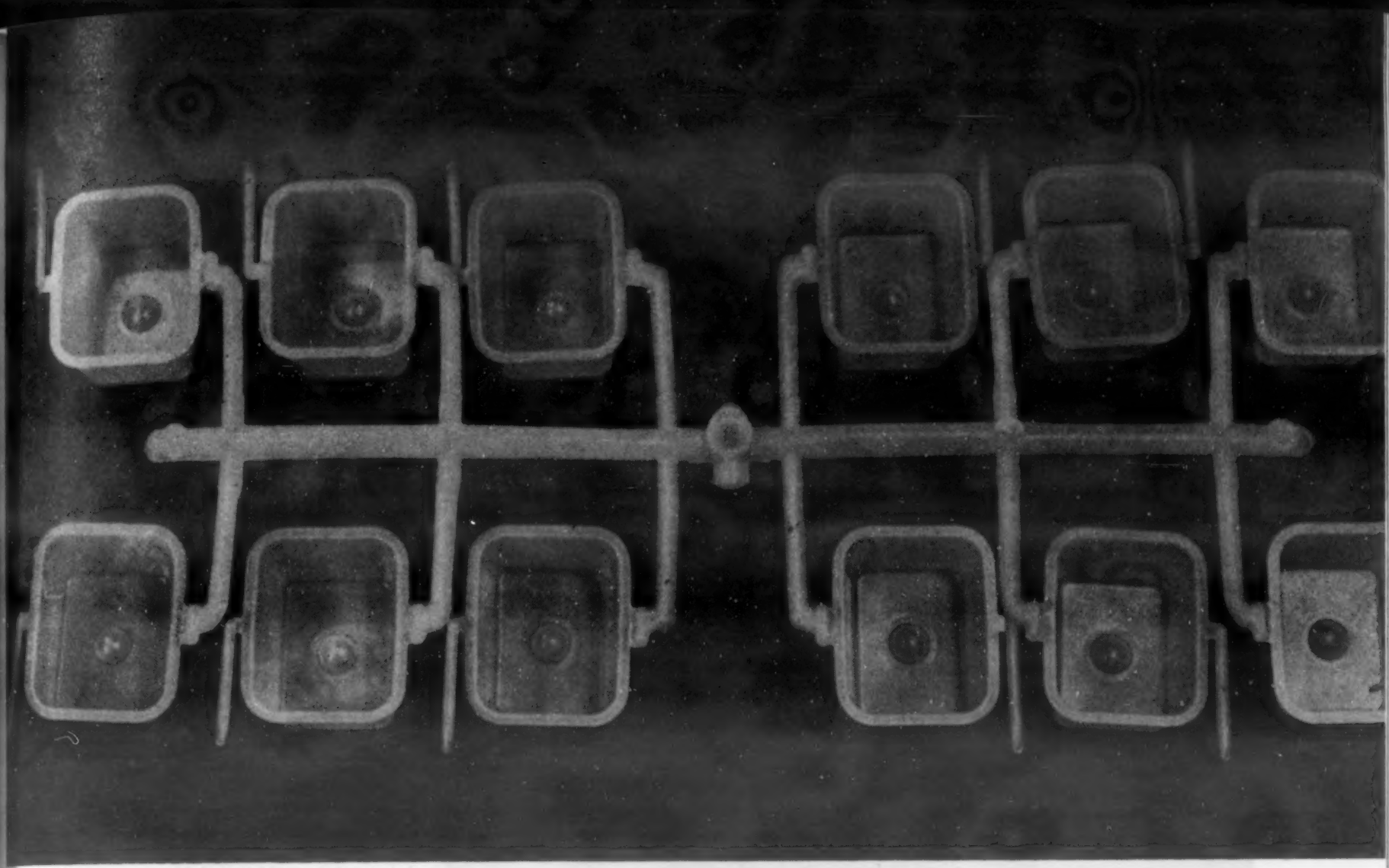
It is only some 40 years ago that the men who suggested the use of the microscope in studying the internal structure of steel were ridiculed. Today we know that we must make use of the newest of those devices, the electron microscope. We know, too, that the spectroscope is not the toy of the physicist. It is the tool of the production metallurgist and is so used in many plants today.

Fabricating processes have become so efficient and steel so sensitive that the effects of minute quantities of unwanted elements are sometimes disastrous. Some elements in quantities too small to be detected by conventional chemical methods are poisonous to deep drawing sheets, others are fatal to the success of welding. The spectroscope detects their presence while the steel is still molten in the furnace and so makes possible their elimination from the finished product.

The secrets of the internal structure of steel are giving way before the X-ray and the gamma ray and as new knowledge is gained new uses are found for it. Presently, the X-ray is the spearhead of the attack on a phenomenon known as "brittle-fracture," one in which ductile steel fails suddenly without exhibiting plastic flow. It was that type of fracture which was responsible for the failure of several merchant ships during the war.

Research has proved that supersonic waves are an important type of energy in testing steel and that they may have value in treating molten steel. The electron tube is used both as a production tool and an inspection tool. It tells when to turn down the Bessemer converter or when the sheet steel rushing from the delivery end of the strip mill at a speed of about 2400 ft. per min. is being held to the desired dimensions. It tells whether or not the coating on tin plate and terne plate and on some wires is continuous. It also tells when the flame in the open hearth is of the proper density, and probably more important, by its use in safety devices it prevents injury to workmen.

All those developments have broadened the fields of metallurgy and, consequently, its areas of research. The research efforts of the steel industry are, therefore, not confined to metallurgical and manufacturing processes only. A goodly portion of them are aimed at solving problems of general social significance such as smoke abatement and the harmless (or even beneficial) disposal of waste acid liquids derived from manufacturing processes. The successful solution of those problems will have a marked effect on human comfort and on the conservation of wild life in all highly concentrated areas.



Cups as made by the new method, shot from 12 cavity mold. 100 such shots are molded and trimmed per hr.

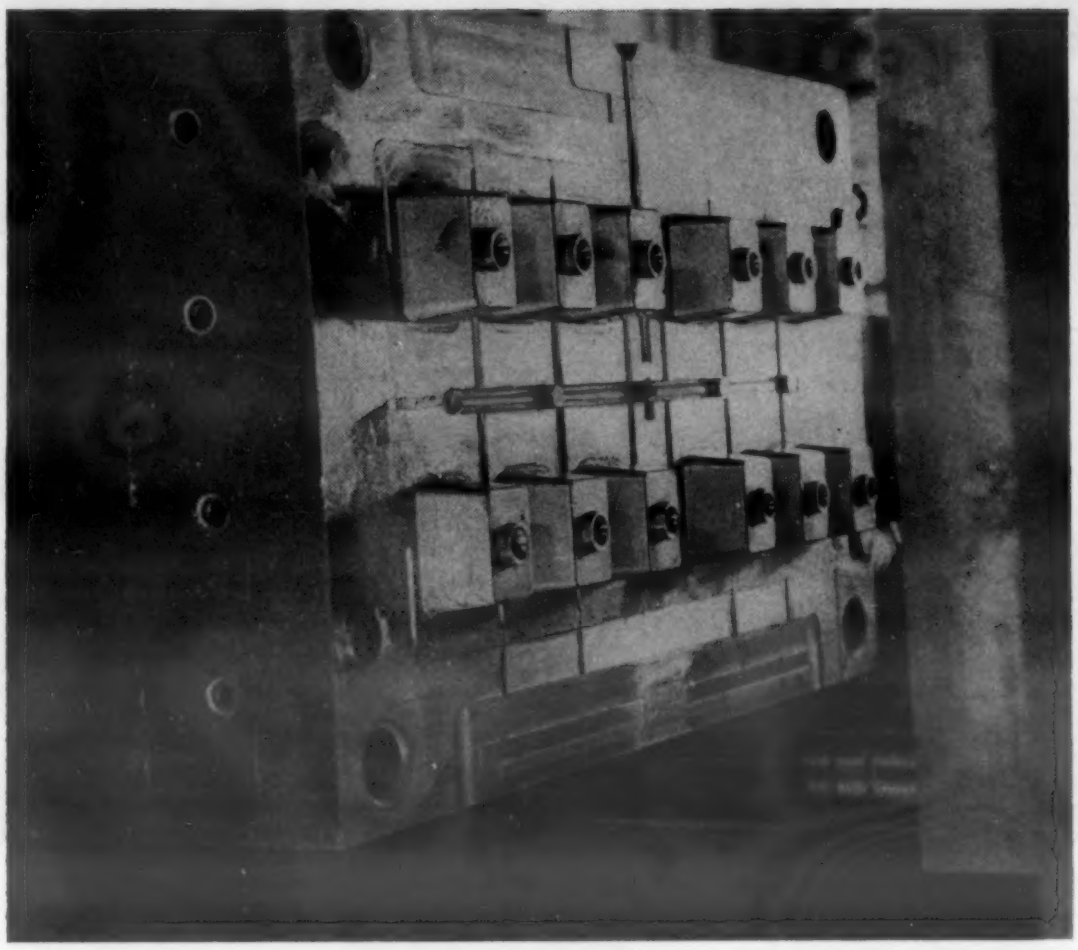
Molding Replaces Forming to Produce Plastic Cup

by **HARRY C. HAAXMA,** *Process & Methods Engineer, Standard Products Co., Plastics Div.*

Despite a higher material cost, switching from forming to molding resulted in considerably lower costs in making cups. This came about through higher output, lower scrap loss, lower labor costs and need for fewer machines.

IN THE MANUFACTURE OF SMALL PLASTIC CUPS designed to serve as individual ice cube formers, means were sought to replace their former method of manufacture. Formerly, they were made of extruded plastic that was heated and then formed to shape. After considerable experimentation it was determined that the thin-walled shapes could be molded satisfactorily in 12-cavity molds. Besides increasing production, the new method reduced labor and other costs.

The part is produced by the Plastics Div. of Standard Products Co., which was asked to take over the project that had been partially set-up at another plant. Twelve such cups were to be placed in an anodized aluminum tray and the unit could be substituted for the conventional tray in the home refrigerator. Since



One of two 12 cavity molds now in production. Photo taken while mold was laid-up and greased to prevent corrosion.

the units were to be used in tremendous quantities low price and high production were of prime importance.

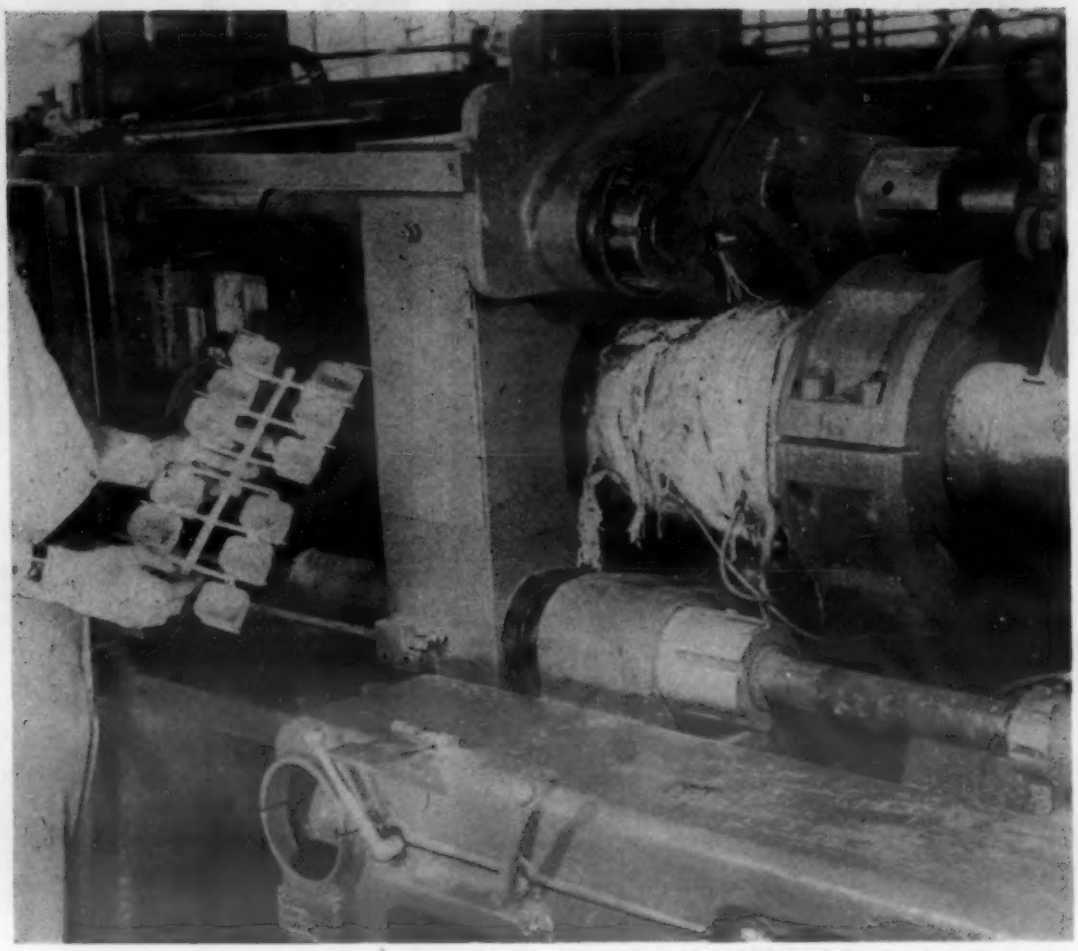
Formerly, the individual cup had been made by forming methods using commercially available ethyl cellulose sheet. One of the major difficulties encountered at that time was rupturing of the sheet as it was drawn, even though it had been heated to the maximum allowable temperature. A special extrusion die was built and adapted to a conventional plastic extrusion machine. This system provided a 4-in. tape or ribbon of ethyl cellulose that was several thousandths thicker at the center of a cross-section than at the edges, and when a cup was formed the extra material at the center was drawn without rupture and resulted in a cup of fairly uniform wall thickness. Even with this development there were many other "bugs" in the process, such as wrinkling of the material when drawn, and above all, the failure of the cups when given accelerated service tests. These failures were manifested as cracks and deformation when the part was subjected to alternate freezing and ejection of the ice cube. It was felt that the failures were due to non-uniformity of the plastic material, which resulted in weak spots when the cup was formed.

The degree of control required at many stages of the former process was far too critical to be applicable to the type of production normal to our plant.

Since this plant is devoted to the injection molding of thermo-plastic materials, we tried to find some way to produce the same or a better cup with the equipment already available. The problem resolved itself to two major considerations: (1) the selection of a material that would fulfill the physical requirements of the cup, and (2) molding this material in production quantities in a part having a wall thickness of only 0.035 in.

After careful study we selected polyethylene as the material, not only for its exceptional physical characteristics but also because it exhibited unusual properties that we felt would enable us to mold such a thin section. Most thermoplastics merely become more "plastic" as the temperature is raised, while polyethylene exhibits what might almost be termed a "softening point." In other words, the temperature-plasticity curve for most materials are smooth, the curve for polyethylene has a flat spot, indicating a temperature at which the material is much more "plastic." This temperature, of course, is the one at which we mold.

Because we had no previous experience in molding this material, we decided to design and build a single cavity experimental mold to try out the various ideas regarding the molding of such a part. The accompanying photographs will show some of the efforts made before a satisfactory design was accomplished. Our first trial (*A*) incorporated a heavy flange around the lip of the cup to provide easy material flow into the cavity. We found that the flow was too easy, resulting in a bad weld at the bottom of the cup which we felt would be unsatisfactory. Samples *B* and *C* were attempts to move the weld up off the bottom to some place on the end or side where the chance for failure would be far more remote. Our final effort was as shown in sample *D*, where the part was gated

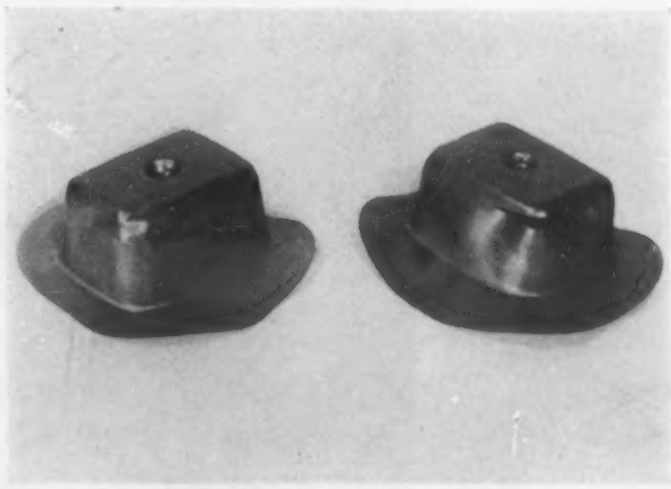


Operator removing shot from 8 oz. Reed-Prentice molding machine. Parts are trimmed in an automatic gate clipping fixture.

on the side with a well or reservoir which allows for enough material movement after the part has almost "set" to push the weld up on the far side opposite the gate to a point nearly at the flange. On the basis of this trial we built two 12-cavity molds for production which have been in operation for about two months. The molds are run in an 8-oz. Reed-Prentice injection molding machine and each mold is capable of producing nearly 10,000 molded cups per shift. The accompanying table shows advantages over the former method of producing these cups.

Comparison of Productive Factors

Item	Former Method (Drawn Cup)	New Method (Molded Cup)
Raw Material Cost per Lb.	$0.63	$0.58
Material Cost per Part.	$0.00516	$0.00589
Production	Extrusion—(material for 1100 cups/hr.) Blank and Form—675 cups/hr. Trim—1500 cups/hr.	One 12-cavity mold produces 1200 cups/hr.
Labor Hrs./M	3.059	0.834
Scrap	20-25%	2-5%
Number of Machines required.	4	1



Typical cups produced by the former method. Scrap losses by the former method ran to about 20%.

Fig. 1—As the first step, bars of SAE 1042 steel are rolled into spirals of six turns.

Fig. 2—Sawing through one side of a spiralled bar results in six near-circles.

Fig. 3—Butt-welding joins the ends of the circular stock to form gear blanks.

Ring Gears Formed from Steel Bar Stock

by **KENNETH ROSE,** *Engineering Editor,* MATERIALS & METHODS

Starter ring gears are being made by a new series of steps which results in a number of manufacturing economies. Typical is a change in heat treating practice which saves almost 2½ hr. per gear.

AS PART OF A PLAN for adopting wartime practices into Studebaker Corporation as rapidly as possible, the procedure for making starter ring gears has been revised. A change in the heat treating process alone has reduced the time for this operation from 2½ hr. to 20 sec., and has produced a more durable product.

The ring gears are made from bar stock in the method in use at Studebaker Corp. Twenty-foot-long bars of SAE 1042 hot rolled steel are the raw material. The final step in the manufacture is a hardening operation that will affect the teeth only, giving them wear resistance, but leaving the ring with a soft cen-

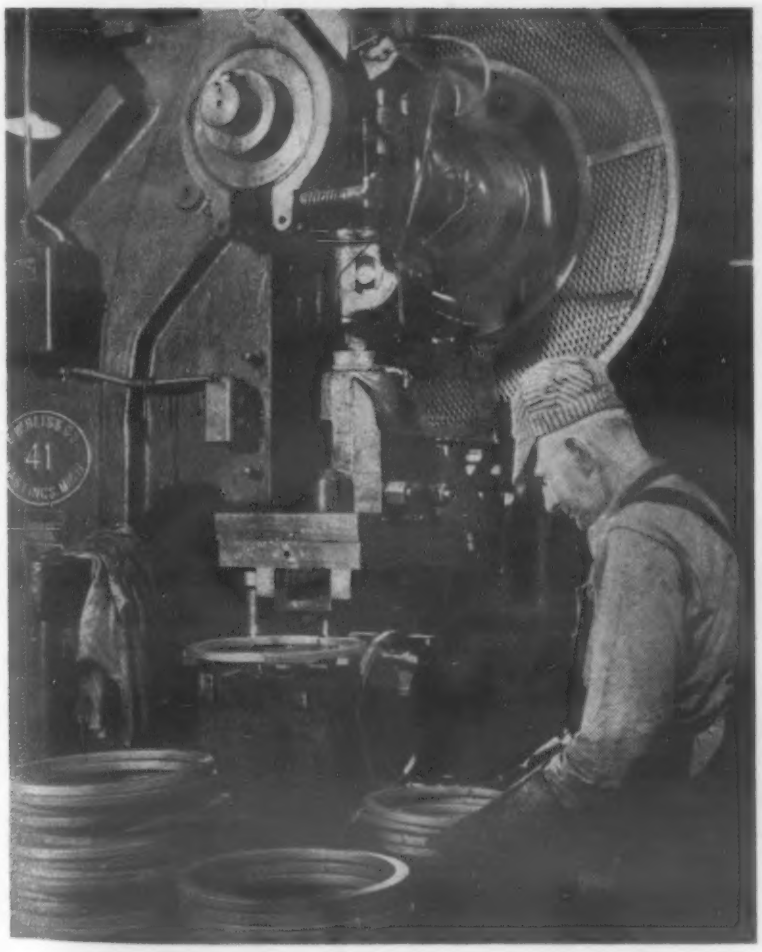


Fig. 4—Welding flash is removed by trimming in a horn press.

Fig. 5—Blanks are forced to exact size on an expander.

Fig. 6—Flatness of blanks is achieved by striking heated blanks in a 2,000-lb. board hammer.

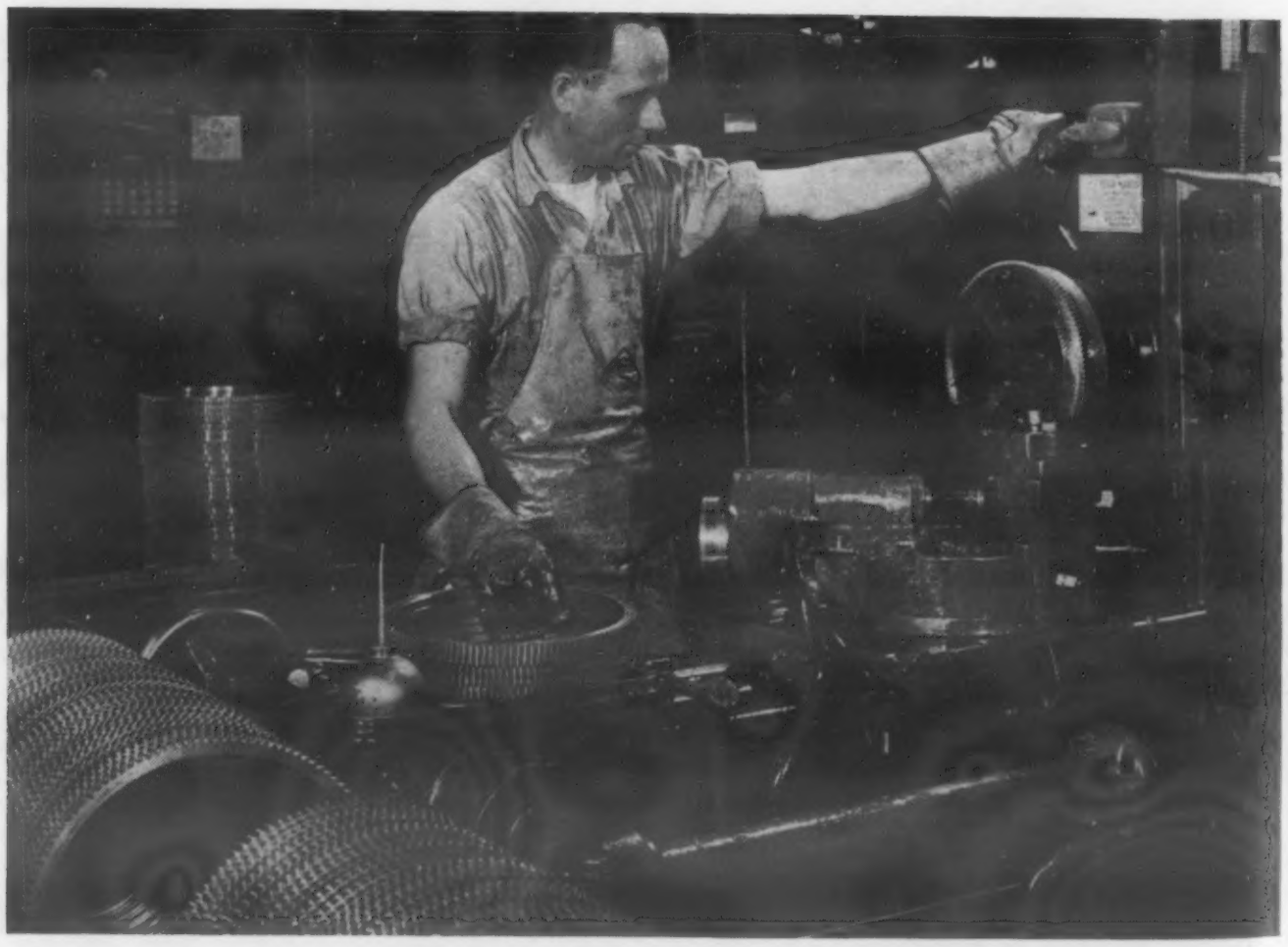


Fig. 7—Blanks are hobbed, 25 at a time. Next, the chamfer is cut and teeth are burred.

ter to permit shrinking it onto the flywheel circumference.

To start the process, the bar is rolled into a spiral, as shown in Fig. 1. Each bar produces a spiral of six turns. Sawing through one side of the spiral with a band saw (Fig. 2) results in six near-circles, made from the bar at the rate of nearly one a min. These are freed from adhering oil by pickling and washing, and are then ready for forming into circles.

The sections of the spiral are pressed into a plane in a welding machine, and are butt-welded to form circles that are the gear blanks (Fig. 3). A normalizing process follows, and the flash resulting from the welding operation is then trimmed off in a horn press. Shearing in two positions trims the four sides (Fig. 4). Expanding the blank to size is accomplished in an expander, as shown in Fig. 5.

To insure flatness of the blank before the machining operations are begun, a hot restriking under a drop hammer takes place. After heating, the blanks are struck in the 2,000-lb. board hammer shown in Fig. 6.

Rough and finish boring of the blanks is done on a multispindle automatic machine, and the inside corner is chamfered. The sides are then straddle faced, the outside diameter turned, and the corners broken on a lathe.

The blanks are then loaded into a gear hobber, 25 at each setup, and the teeth are cut. In the next operation, shown in Fig. 7, the chamfer is cut and the teeth are burred. The part number is stamped on in a marking machine, and the piece is washed in kerosene in preparation for the heat treatment.

The 124 teeth on the periphery of the gear must be hardened without affecting the remainder of the gear. Induction heating is used to bring the outside ¼ in. to hardening temperature quickly enough to avoid conduction of the heat to the body of the piece, and a quench in water accomplishes the differential heat treatment. These gears were formerly heated in a gas oven for 1 hr. to reach hardening temperature, were quenched, and then were given a draw to reduce the hardness of the body of the gear. The draw required an additional 1½ hr.

In addition to saving time, there are fewer rejects due to distortion or brittleness than with the old method.

The gears are brought to the induction heating unit, and a piece is placed in the fixture (Fig. 8). The fixture spins at 75 rpm. to insure even distribution of the heating effect, and the current is turned on in the two-layer, water-cooled coil fitting around the gear. A frequency of 540,000 cycles is used. Within 13 sec. the temperature is brought up to 1500 F, the current is automatically turned off, and a water spray strikes the part to quench it. The quench requires 7 sec. (Fig. 9).

A dip into an antirust preparation follows. The gear is then drawn at 475 F for 30 min. to expand and make possible a shrink-fit on the fly-wheel.

Fig. 8—While being inductively heated, the gears revolve at 75 rpm. to insure even heating.

Fig. 9—Quenching is through water spray on the gear while it is still in its fixture.

Electropolishing, which is in effect reverse plating, is proving highly satisfactory as a method of finishing silver-plated objects. Considerable hand finishing work is thereby eliminated, with a worthwhile saving in material and a reduction of 50% in the cost of finishing labor.

Electropolishing Silver-Plated Parts in Cyanide Solutions

by DANIEL GRAY, *Oneida, Ltd. and* S. E. EATON, *Arthur D. Little, Inc.*

Hand buffing is the traditional method of finishing electroplated silver.

TO REPLACE OR MINIMIZE a dirty, expensive and inefficient factory operation by introducing one that is clean, cheap and efficient appeals to any management. The possibility of doing so is well exemplified by a process for electropolishing silver developed in the laboratories of Arthur D. Little, Inc., Cambridge, Mass., under the sponsorship of Oneida, Ltd., Oneida, N. Y.

The traditional method of finishing electroplated silver, as well as many other metals, is hand-buffing. This consists in applying an abrasive compound to a rapidly moving wheel, after which the work to be polished or buffed is held against the wheel with sufficient pressure to abrade or flow the metal. The process is obviously dirty and dusty. Its use involves problems in protecting the health and morale of workers by ventilation and other methods.

There is another sound reason for minimizing hand-buffing. With a wheel of fixed diameter and face-width it is obviously impossible to apply equal pressure to all parts of an irregular object. In striving to polish less accessible areas undue pressure may be brought to bear on other parts, particularly edges. This may result in completely removing the deposit. This defect (called "line-stripping") is a familiar one. In the case of high-quality merchandise it can be a serious problem.

Electropolishing of silver as carried out at Oneida, Ltd., on the other hand, is clean, fast and low in cost. As many as 72 pieces are polished at a time. Routine analysis of the electropolishing solution and an occa-

Through electropolishing it is possible to secure as high a luster by removing 2% of the silver deposit as would be possible through removing 5 to 10% by hand buffing. Left to right the illustration shows spoons in the electropolished, plated and commercial finish conditions.

sional setting of a voltmeter comprise the man-power involved. With electropolishing, it is possible to secure as high a luster by the removal of 2% of the silver deposit as would be possible by removing 5 to 10% by hand buffing. This, of course, results in improvement of the finished article.

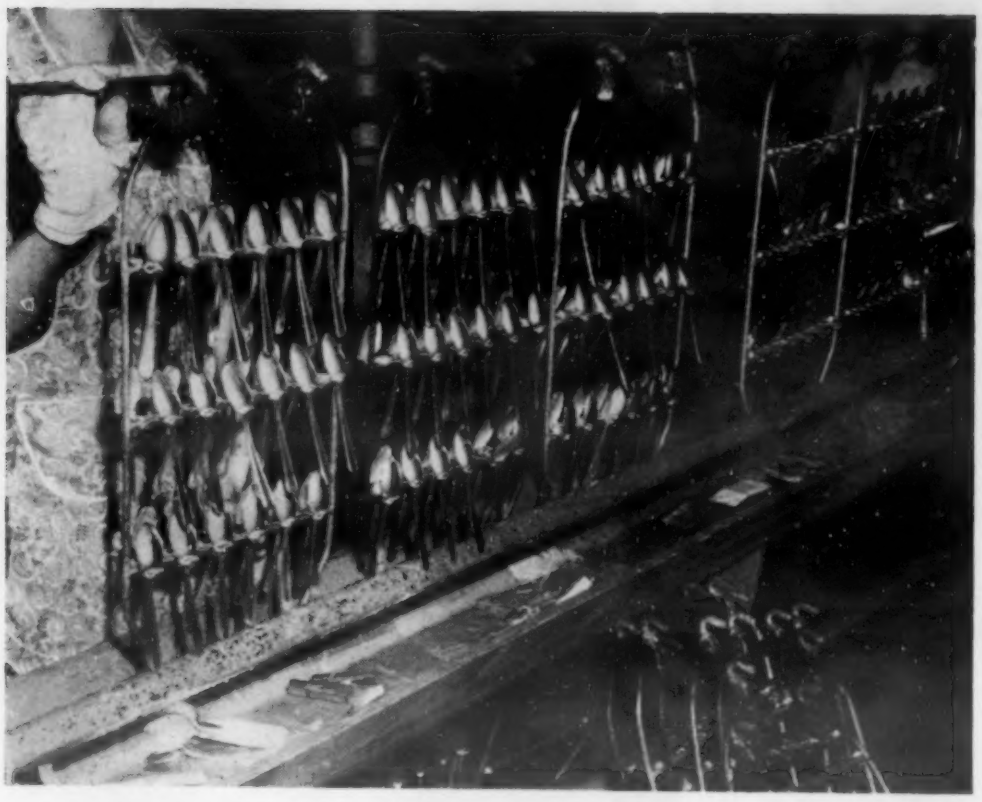
It must be made clear that electropolishing does not necessarily eliminate all finishing operations. Esthetic requirements in the field of tableware, for instance, demand that the brilliant glitter of an electropolish be softened. A suitable patine is given by various wheel operations, such as rubbing with a compound of very fine alumina. This rubbing, however, must be done on a bright surface, which is conventionally obtained by rouge-buffing to a high luster. Electropolishing, requiring practically no manpower, replaces the buffing with a saving of 50% or more of the cost of labor in finishing. Added to the reduction in labor cost are the savings in buffing compounds, wheels and cost of recovering silver from the buffing dust. In a large establishment employing hundreds of finishers, these items are substantial.

Electropolishing is the reverse of electroplating. In plating, the work is made the cathode (negative) and metal is deposited. In electropolishing, the work is made the anode (positive) and metal is removed. Electropolishing in general is a relatively new process. Development in the past ten years has been rapid, particularly for stainless steel.

As most electroplaters know, the optimum current density for silver anodes in a normal cyanide plating bath is limited to the range where perfect corrosion takes place. If this is exceeded the anodes will "cast" over, corrode irregularly or in some cases become polarized or passive. When this occurs the balanced composition of the plating bath may be destroyed and defective plating result. Curiously enough, certain current densities in the polarizing range, which platers normally avoid, are best for electropolishing.

It is fascinating to watch the experimental electropolishing of an article in a large glass beaker. In a typical experiment a silver-plated article is agitated by moving in a circular path in the cyanide solution described below. A voltage is applied between the cathode and the anodic article to be polished, and is gradually raised until the silver surface flashes over with a light brown film which would disappear quickly if the current were cut off. As the voltage is maintained in this region, the article becomes brighter and in a short time develops a brilliant luster.

It may be interesting to note that activity in the electropolishing of silver arose from a casual observation. Silver plating baths are preceded by "strike" solutions, which apply a very thin coating of silver to give good adherence of subsequent plate. In these the metal content is low and the current relatively much higher than in the plating bath itself. It was noted that the anodes in the strikes became smooth and in some areas bright. About ten years ago one of the authors was assigned the task of studying this phenomenon in the laboratory. The results were so startling that the study was made a major project.



Spoons, forks or other plated articles are mounted on plating racks, plated and then dipped into the electropolishing bath.

Arthur D. Little, Inc. was asked to make a complete study and, if possible, develop a practical method for factory use. The process described in this article was the result.

Most electropolishing processes use acid solutions. This new one, on the other hand, employs an alkaline cyanide solution. It was found that there are several modifications of the process, each of which has its own best application. The modification in use by Oneida, Ltd. for nearly a year and a half is well suited to electrodeposits up to about 0.002 in. This involves a short electropolishing cycle after the plating is complete. The fact that the process was installed on pre-war automatic machines built long before electropolishing was conceived is evidence of its flexibility and adaptability.

Process Simple to Apply

At Oneida, Ltd., spoons, forks, and other articles are mounted in plating racks and plated in a typical cyanide bath. The racks are lifted automatically from the plating bath. They then pass over a drip-pan, following which they go into the electropolishing bath without intermediate rinsing.

The details of the process are simple. The solution itself is essentially a silver plating bath. The composition is roughly:

Silver:	4 to 6 oz. Troy per gal.
Potassium cyanide:	4 to 5 oz. Avoir. per gal.
Potassium carbonate:	6 to 8 oz. per gal.

About 5 volts d.c. potential at the source is applied, with the work to be polished used as the anode. The voltage across the cell itself varies with the area of the work to be polished. The cathodes are bars of silver. Although the cathode area is not critical, it should be large enough so that efficient deposition of silver may occur. A ratio of 1:2, anode to cathode is desirable. Incidentally, the silver removed is here recovered as pure metal. The saving in refining charges, as compared to the cost of recovering silver from buffing dust, is considerable. The current required is 12 to 25 amp. per sq. ft. The polishing time is 15 to 18 sec., depending on the speed at which the machine is run. While being polished the work is moved by a screw conveyor for a distance of about 10 in. The full luster is not apparent until the work is dry.

The preceding example describes the process as used on one particular machine. Other polishing machines at Oneida, Ltd. vary in some details, such as solution composition, current density and time of treatment. For instance, on two machines there is no drip-pan. The work goes directly from the plating bath into the electropolishing unit. The drag-in of plating solution on the surface of the work is considerable and it is necessary to adjust operating conditions so that a polishing solution compatible with the plating bath can be used. The point is that the process can be varied to suit conditions and obtain good results.

The great flexibility of this process may be ascribed to the fact that the factors of control are known, measurable and inter-dependent. These are: solution composition, voltage (or current), agitation, time and temperature. As cyanide content or temperature increases, more current is necessary. As carbonate content increases current demand is decreased. By varying one or more factors it is possible to produce a mirror finish in from 4 to 60 sec. Obviously any desired amount of silver may be removed. The current efficiency of both cathode and anode is nearly 100%. The principal cause of variation in the electropolishing bath is drag-in on work. Since the viscosity of the polishing bath is low, the drag-out loss is not im-

As many as 72 pieces of silver-plated tableware are electropolished at one time.

portant. The solution is easily maintained by analysis and additions.

When mere brightness of the work is the sole requirement, further finishing may be unnecessary. There is, however, a second result from electropolishing that deserves special mention. In the polishing range of voltage, the tendency is to attack and reduce high-points. If the process proceeds long enough, this tendency results in a smooth deposit. Where a flawless surface is desired, this smoothness is as important to further finishing operations as mere brightness. In many types of work, this aspect of electropolishing is important because cutting down frostiness, roughness or lumps by hand-buffing is slow, costly and uncertain.

Although this exposition has been confined pretty much to a discussion of electropolishing silver, the process is suitable for other metals. At the time of writing the only commercial, full-scale application is to silver. Active research has demonstrated that copper, cadmium, copper-alloys such as brass, sterling silver and some other alloys may be successfully polished.

It should not be assumed, from the somewhat deceptive simplicity of the process as described, that anyone can set up a bath over-night and operate it successfully. Each application, in order to be economically feasible, must be specially tailored. The general rules, however, have been pretty well established by years of research, laboratory-scale operation and commercial application.

A patent (U.S. No. 2,416,294) has recently been granted on this process. Several others are pending. Oneida, Ltd. holds exclusive rights on silver. Arthur D. Little, Inc. is continuing the development in fields other than silver. Consideration is being given to licensing under the patent already issued and others as issued.

While the authors have perforce dwelt principally on tableware, there would seem to be no limit to the field. It is not even necessary to think only of plated articles. Where it is desired to get a good luster on intricately shaped articles, such as costume jewelry, highly ornamented articles such as picture frames or even on plain surfaces, this method is well worth considering.

Electropolishing does not eliminate all hand finishing, since it is sometimes necessary to soften the brilliant glitter achieved.

In selecting materials for a new motor design it was desirable to know how steel and cast iron compared for the conditions and types of service involved. Results of comprehensive tests showed that, with the finishes involved, steel offered greatest corrosion resistance.

Is Cast Iron Superior in Corrosion Resistance to Steel?

by **R. W. WHITE,** *Materials Engineering, Westinghouse Electric Corp.*

THE DESIRE TO SECURE STRUCTURAL and economic advantages by the use of steel in place of cast iron in the construction of electric motors has led to tests which contradict the longstanding empirical assumption that iron is more corrision resistant than steel. These tests prove that, while bare steel and cast iron are equally resistant to corrosion, surfaces of steel given a properly applied standard motor paint finishing system are more resistant than cast iron given the same treatment.

The erroneous belief in the superior corrosion resistance of cast iron has been perpetuated by the fact that thin cross-sections of steel when substituted for heavy castings rusted through faster. Account was not taken of the large difference in cross-sectional thickness. Only recently has the accumulated evidence of investigators shown that the various external environmental conditions to which steel or cast iron parts are subjected rather than differences in composition are the governing factors in corrosion.

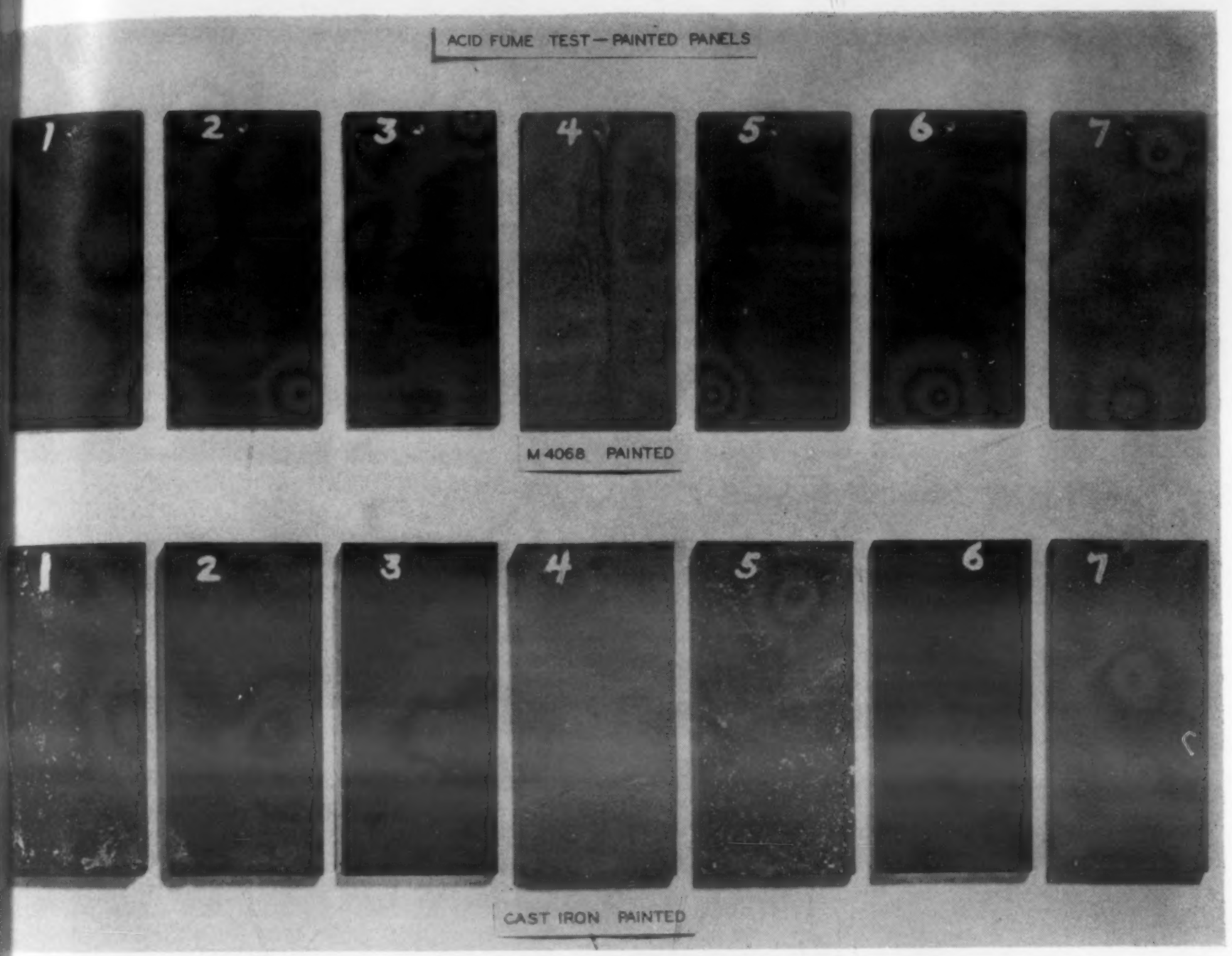
In conjunction with the design of a new electric motor made from steel, it was desirable to substantiate the findings of previous investigators by adding to the corrosion resistance rating data. In the change-over to steel an improved shock resistance and a considerable savings in the size of steel parts as well as a greater dimensional accuracy in the forming of intricate parts was looked for. In comparison to a rough casting, the eye-appeal of a smooth surface finished with organic materials was inviting.

The corrosion tests that were made to determine the relative corrosion resistance of bare and coated cast iron and steel were necessarily accelerated, and no attempt should be made to interpret them as service tests.

Materials Tested

The series of tests carried out were designed to discover the comparative rating of hot rolled steel (pickled) and cast iron of the type used in the past. Table I gives a chemical analysis of the metals, tested.

Since a motor is never put in service without several coats of organic finishes, including insulating varnish, inhibitive primer, and enamel finishing coats,



Painted steel (top) is superior to painted cast iron (bottom) when exposed to acid fumes.

emphasis is placed on the comparative results of the two metals when they are enamel finished.

The organic coatings act as physical barriers which more or less effectively exclude the corrosive elements of the environment from the metal surface. Both moisture and oxygen permeate the coating, however, so that the basis metal may corrode to some degree.

The test samples were divided into bare metals and metals coated with organic finishing systems.

In the bare metals tests cast iron samples were exposed in two sets; shot-blasted and machined. These were compared with steel samples as received from the mill after degreasing and machined, respectively. This comparison was made because castings for motors are shot-blasted and steel is used as received after degreasing, while some parts of the motors are machined regardless of which metal is used.

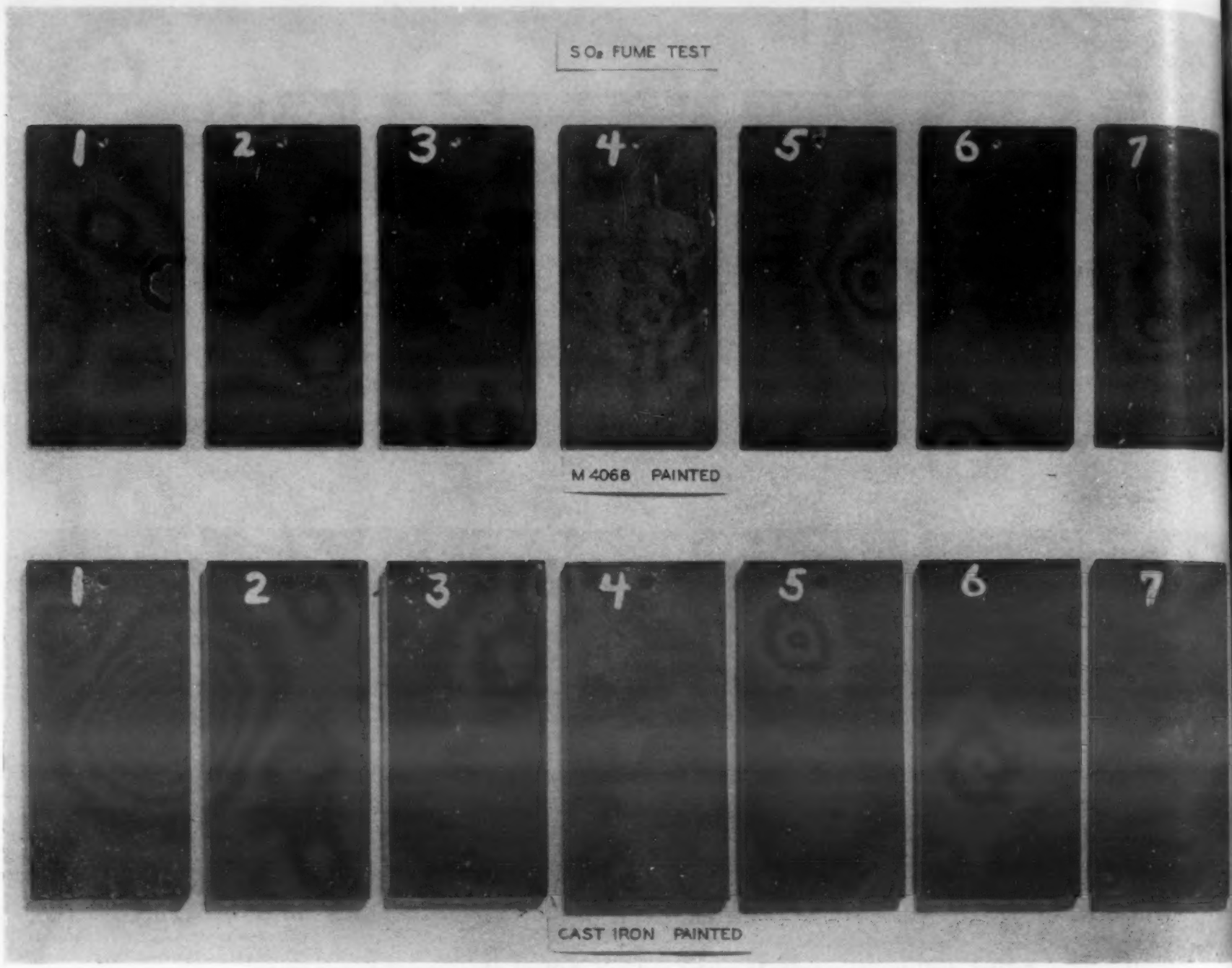
In the tests on metals coated with organic finishing systems, painted panels of sandblasted cast iron were compared with painted panels of steel degreased in trichloroethylene. Seven different paint finishing systems were applied to samples. These finishes were applied to the cast iron and steel panels simultaneously by the spray gun method, thereby insuring the same film thickness on both metals. Finishing systems Nos. 1, 2, 3, 4 and 5, listed in Table III, were different types of two-coat systems while Nos. 7 and 8 were three-coat systems.

Test Conditions

In choosing the test media it is conceded that no one test or series of tests can hope to cover all environmental factors encountered in service. However,

Table I—Analyses of Materials Tested

Material	Composition %					
	C	M	P	S	CU	SI
Steel	0.05	0.39	0.009	0.023	0.06	—
Cast Iron	3.40-3.55	0.60-0.80	0.20	0.12	—	2.40-2.60



Steel (top) and cast iron (bottom) after exposure to SO_2 fumes.

the most common causes of corrosion are excessive moisture, oxygen, salt air, SO_2 fumes, other organic acid vapors, and sunlight. Either singly or combined the following test media were used:

I. *Salt Spray Test*
The samples were exposed to a salt fog atmosphere from a 20% salt solution at a cabinet temperature of 95 F and 84% relative humidity.

II. *SO_2 Fume Test*
The test samples were suspended in a glass jar over water saturated with SO_2. The water was changed every 48 hr. and additional SO_2 bubbled into the water. Vapors were sealed in by a glass lid and the test conducted at room temperature from 23 to 27 C (74 to 80 F). The samples were rotated each 48 hr.

III. *Water Vapor Test*
The test panels were exposed to a moisture

Table II—Results of Tests of Bare Metal

Tests	Rusting in Grams per Sq.Cm. — 720 Hr. Exposure					
	Salt Spray	Water Spray	SO_2 Fume	Weather-ometer	Acid Fume	Average 5 Tests
Steel (as Received)	0.1294	0.0408	0.1778	0.0437	0.0065	0.0796
Cast Iron (Shotblasted)	0.1697	0.061	0.1852	0.0488	0.0070	0.0943
Steel Machined	0.1278	0.0444	0.1248	0.0476	0.0068	0.0702
Cast Iron Machined	0.1322	0.0461	0.1321	0.0476	0.0074	0.0730

saturated atmosphere created by an aerated water spray. The cabinet temperature was maintained at 95 F.

IV. *Acid Fume Test*
The test samples were subjected to the action of the fumes of a mixture of 5% solutions of nitric, hydrochloric, and sulfuric acid. The test was conducted at room temperature of 23 C to 27 C. Panels were rotated each 48 hr.

V. *Weatherometer Test*
The test panels were exposed on a rotating drum to ultra-violet light from a carbon arc lamp. Three times each hour the panels are wet by a water spray. Panels are alternately wet and dry.

Bare Metal Exposure Test Results

The tests were severe enough to form heavy rust coatings in 720 hr. on the bare metal panels. These were weighed before testing, exposed to test conditions, cleaned with sodium hydride and reweighed. Table II gives the results expressed in grams weight loss per square centimeter. Graph No. 1 depicts the cumulative rust when rust on each succeeding exposure test panel is added to the total of exposure tests preceding it on the graph.

Tests showed the rusting of the machined samples to be practically the same. The steel samples as received from the mill average 15% less rust on the five tests than the cast iron samples.

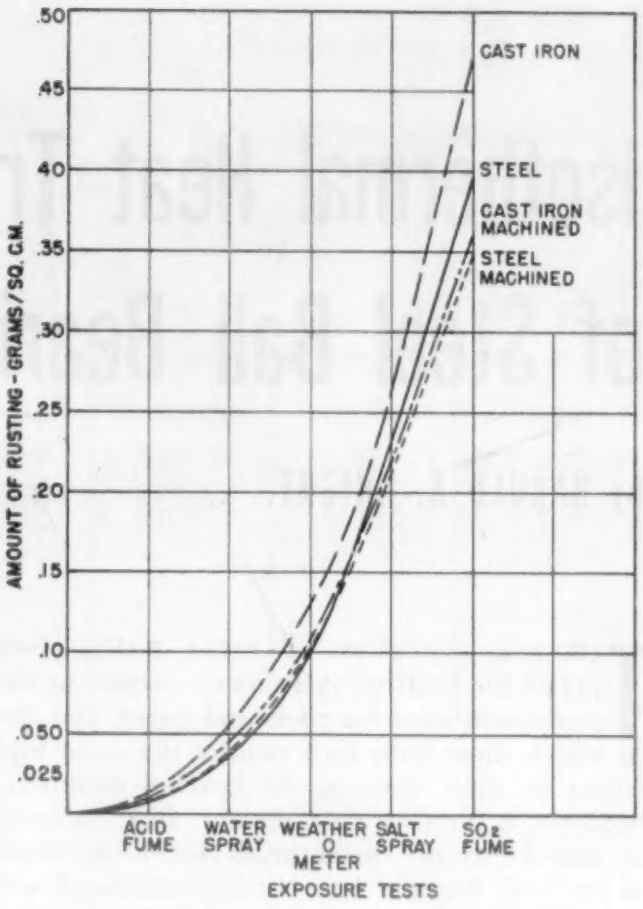
One reason for heavier rust film on the cast iron which has been shotblasted is that roughened surfaces provided more actual surface area per unit of macroscopic area. Shotblasting gives a surface area increase which could account for heavier rust films.

The test results indicate that if the metal is not finished with an organic coating, steel has rust resistance comparable to cast iron of equal thickness.

Varnish and Enamel Coated Panels

The results of the steel and cast iron panels finished with organic coatings and exposed to the five test conditions are tabulated in Table III. The results are expressed in terms of the number of rust spots or the percentage of the area covered by rust spots when the attack was severe. These results indicate the superior corrosion resistance of the steel when coated with the same thickness of organic finishing materials as cast iron.

The cast iron rusted at a faster rate than the steel because the roughness of the sandblasted surface results in high and low spots. When coated with lacquer or enamel, the liquid fills in the low areas first and the film shrinks down over the high points as the solvent evaporates. A thinner film at these points and, consequently, less protection for the metal results. Once it is formed, rust collects moisture and more rust is formed. This rust tends to spread under the paint film. Rolled steel, on the other hand, is relatively smooth and a comparable volume of lacquer or enamel covers uniformly, giving greater overall protection to the metal.



Cumulative amount of rusting on cast iron and steel panels.

Table III—Corrosion Tests: Steel and Cast Iron Panels with Organic Protective Finishes

Test Hr. Exp. Metal	Salt Spray 1824 hr.		Water Spray		Acid Fume		Weatherometer		SO_2 Fume	
	Steel	Cast Iron	Steel	Cast Iron	Steel	Cast Iron	Steel	Cast Iron	Steel	Cast Iron
System 1	6 R.S.	25% R.S.	36 R.S.	38 St.	No R.S.	150 R.S.	No R.S.	10 R.S.	B	250 R.S.
2	5% R.S.	95% R.S.	30 R.S.	24 St.	125 R.S.	300 R.S.	No R.S.	36 R.S.	B	150 R.S.
3	4 R.S.	20% R.S.	48 R.S.	24 R.S.	No R.S.	12 R.S.	No R.S.	36 R.S.	B	50 R.S.
4	4 R.S.	8% R.S.	6 R.S.	24 R.S.	No R.S.	10 R.S.	No R.S.	4 R.S.	No R.S.	20 R.S.
5	No R.S.	80% R.S.	3 R.S.	40% R.S.	B	20% R.S.	No R.S.	70% R.S.	20 R.S.	250 R.S.
6	3 R.S.	5% R.S.	No R.S.	12 R.S.	No R.S.	12 R.S.	No R.S.	2 R.S.	No R.S.	4 R.S.
7	No R.S.	36 R.S.	No R.S.	24 R.S.	No R.S.	10 R.S.	No R.S.	4 R.S.	No R.S.	6 R.S.

R.S. — Rust Spots % — Percentage of total area rust spotted B — Blistered St. — Rust streaks

Isothermal Heat Treatment of Steel Ball Bearing Races

by **HAROLD A. KNIGHT,** *News Editor,* MATERIALS & METHODS

THE MANUFACTURE OF STEEL BALLS AND ROLLERS for bearings is a process carried to the same precision used for tools and gages, and the races in which these balls turn require the same high precision in their making. As bearing members, high hardness is another requirement. Fine surface finish is also a "must" specification for these steel parts if the long life and low friction associated with this type of bearing are to be obtained.

In the case of the bearing races particularly, the specifications pose a difficult problem for the heat treater. The shape of the pieces (rings, in the case of the ordinary bearing for a suspended shaft) makes distortion a likely result during the hardening stage when the volume changes associated with the austenite-martensite transformation take place.

The isothermal quenching of steel, in which the cooling rate is reduced during the transformation of these metallographic constituents, has become the standard method for obtaining distortion-free results. Slow cooling rates, or holding of constant temperature for the critical points on the transformation curve, permit the volume changes to take place evenly throughout the piece, and to adjust themselves without causing distortion.

For its production of inner and outer ball races for the automobile industry, Jack and Heintz Precision Industries, Inc., Cleveland, has adopted the isothermal method of heat treating. An elaborate salt bath furnace, composed of four baths and a wash tank built into a unit, has been installed to permit isothermal treatment of these and other small parts. The furnace is of Ajax-Hultgren manufacture, and is completely automatic, only one man being required to load and unload the conveyors. It has a capacity of 450 lb. of steel per hr., but an additional helper may be required for loading and unloading certain types of work if the furnace is operated at capacity.

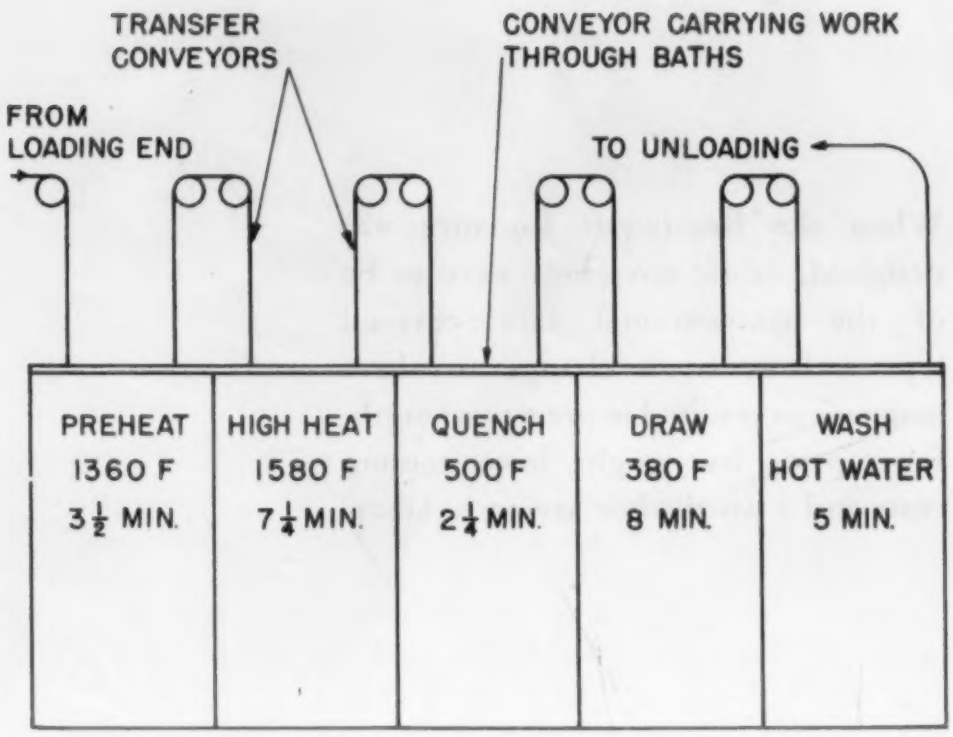
Controlled quenching of ball races was selected because of the distortion problem inherent with circular parts. Isothermal quenching permits even volume changes throughout the piece at critical transformation points. Through this method a preliminary grinding operation is dispensed with.

The ball races are machined from steel tubing. The analysis specified is S.A.E. 52100 steel. Turning inside and outside circumferential surfaces, cutting the groove for the race, and facing off both ends is done on automatic screw machines. A rough grind follows, and the races are then ready for heat treating.

At the loading and unloading end of the furnace the races are strung onto wire holders having a frame of alloy or cold rolled steel rod to support the races while immersed in the molten salt. Longest life has been obtained with the alloy frames, and the 60 nickel, 15 chromium alloy seems to give best results. The holders are made with a flattened loop at the top so that their is nothing to prevent the rings sliding off the holders when the string is inverted over a tote box. Loading of the holders is also simplified.

Each string holds about 20 parts, and five strings are suspended onto each bar on the chain conveyor feeding the furnaces. The conveyor consists of a pair of chains, one on each side of the furnace, which pick up the bars extending the width of the furnace. The bars holding the work are moved along by the chains to the first salt bath. The chains pass over sprocket wheels at this point and move downward, lowering the bar to the top of the furnace, and the suspended work pieces into the salt bath. As the bar reaches the top of the furnace it is picked up by another pair of chains, one on each side of the furnace, and the work is slowly moved through the molten salt. A limit switch shuts off the loading conveyor chains as soon as the bar leaves them.

The use of these two sets of conveyor chains makes the operation of the furnace completely automatic after it is loaded. The bar from which the strings of races are suspended is carried over the salt baths by a pair of slowly moving conveyor chains and, as it



Schematic diagram of the salt bath furnace used by Jack & Heintz for isothermal heat treatment of steel ball bearing races.

reaches the end of travel at each bath it touches a limit switch that starts another pair of conveyor chains, moving upward to lift the work out of the bath, then horizontally to a position over the next bath, then downward to place the bar on to the slowly moving chains and the work in the next bath. A second limit switch shuts off the small motor driving the vertically-moving conveyor.

The first salt bath is a preheat bath, maintained at 1360 F. As with all the baths, heating and temperature control are done electrically. The races, of small cross-section, come up to temperature very quickly, and 3½ min. is ample for effective preheating. The second salt bath is the high heat, and here 1580 F is the operating temperature. A 7¼-min. soaking period is provided. In the next bath a temperature of 500 F is provided for quenching, and the work remains in this section for 2¼ min. The draw takes place in the fourth section, where the molten salt is held at 380 F. The races remain here for an 8-min. period.

After completion of the heat treatment, the work is placed in the wash water tank at the far end of the furnace, the same system of chain conveyors handling the bar from which the strings of races are suspended. Five min. in the hot water in this section completely removes any salt that may adhere. At the conclusion of the washing period the bar is picked up by the last pair of chain conveyors and raised to the top of the frame over the furnace, then carried back to the loading and unloading station, where the races are slid from the holders into baskets.

To complete the removal of any traces of salts that might have escaped the action of the hot water, a rinse in an Oakite solution follows. The basket is placed in a tank separate from the furnace, and swirled about. The cleaning solution also helps to remove any traces of oxide that might have formed on the surface of the parts. Several rinses in water are used after the cleaner to free the work from all traces of the solution.

The races as they leave the last rinse are clean but not bright. A bright finish is not required, inasmuch as a finish grind is needed to bring the parts to size. The parts have a faintly grayish cast that is not objectionable on nonfriction surfaces.

Hardness is held between 62 and 62½ Rockwell C. Distortion is held within a few ten-thousandths.

The races are completed by grinding the outside circumferential surface and the groove of the inner races, and the inside circumferential surface and the groove of the outer races. About 0.0025 in. is removed by the finish grind.

Some difficulty was experienced at first with longitudinal hairline cracks that appeared upon wet Magnaflux inspection. These were thought to be grinding cracks, and a careful study of grinding procedure was made. It was finally found, by grinding several of the defective pieces several thousandths undersize, that the cracks were associated with the original surface of the metal, and that insufficient stock was being removed in the machining operations to eliminate them completely. They disappeared when a small additional amount of stock was removed. Stock removal on the sizes in the 2½- to 3-in. range, finish size, was about 0.037 in. overall.

The excellent surface finish and almost complete absence of distortion obtained with the present heat treating procedure indicates that the rough grinding preliminary to heat treatment can be eliminated, and this step will be taken in the near future.

Heat treatment of races of about 3-in. dia. is about at the rate of 3000 to 3500 per hr., with one operator at the furnace. With smaller sizes the rate may rise to about 6000 per hr. This is not the capacity of the furnace, as determined by its maximum heat output, but is the rate arrived at by the details of handling the work.

When the Beechcraft Bonanza was designed, fabric coverings were to be of the conventional fabric-covered type. However, a change to sheet magnesium resulted in greater strength, fewer parts, less weight, lower tooling costs and a worthwhile saving in labor.

Magnesium Replaces Fabric for Aircraft Control Surfaces

by **R. E. SAUNDERS,** *Production Engineer, Beech Aircraft Corp.*

BEECH AIRCRAFT HAS FOUND many advantages through the use of magnesium alloy in the production design of control surfaces on the Bonanza. The control surfaces (flap, aileron and elevator) of the first or experimental Bonanza were of the conventional fabric-covered type. The primary structure of each of these surfaces was of the intercostal rib construction. Each of these control surfaces were tested satisfactorily and were approved by the C.A.A. for use as primary control surfaces on the Bonanza. When the decision was made by the Beech engineering department to change to magnesium control surfaces, the change was considered as an improvement change. As the design, testing, and tooling of the magnesium surfaces were completed these assemblies were released for production. Shown are pictures of each magnesium surface compared with the original design with fabric removed. The magnesium surface has been disassembled in each picture to show the number of detail parts. A comparison of these components shows a total saving of 337 parts per ship.

Control Surface	*Fabric-Covered Surface*	*Magnesium Surface*	*Saving Per Ship*
Flaps	149 Parts	28 Parts	121 Parts
Ailerons	136 Parts	40 Parts	96 Parts
Elevators	154 Parts	34 Parts	120 Parts
		Total	337 Parts

In each surface the only ribs which were used were end and closure ribs around hinge cut-outs, etc. The elevator and aileron skins are fabricated from one-piece blanks of 0.020 FS-1H magnesium alloy. Flap skins are fabricated from one-piece blanks of 0.025 FS-1H magnesium alloy. In each case these gages represent the minimum material gage available in the required width from the mills.

A completely assembled sheet magnesium-covered elevator. Spot-welds are visible.

Advantages gained from a structural standpoint are quite obvious from the following comparison. Both ailerons were static tested to destruction for the same design condition. The magnesium aileron failed at 210% of ultimate design load, whereas the fabric-covered aileron failed at approximately 150% of ultimate load. Normally under this condition the magnesium alloy surface would have been redesigned to reduce the strength to slightly above 100% of ultimate design, and arrive at a greater strength-weight ratio. However, due to the fact that all material with the exception of the spar is made from minimum material gages available, this was not attempted. The two end ribs and the two hinge cutout ribs are from 0.020 FS1-A magnesium alloy sheet, the spar from 0.025 FS-1H magnesium alloy sheet, and the trailing edge spacer is from 0.020 FS-1H magnesium alloy sheet.

More important than the ultimate strength of this surface is the excellent stiffness obtained from the torque box formed by the trailing edge skin, spar, and end ribs. Deflections at various points along the trailing edge were observed during static test of both ailerons. At 100% ultimate design load the deflection of the magnesium surface averaged less than 50% than that of the fabric-covered aileron, which is a very desirable feature for movable control surfaces. In addition, no buckles were visible in any panel of the skin at 180% of load during static test. No strain gages were used.

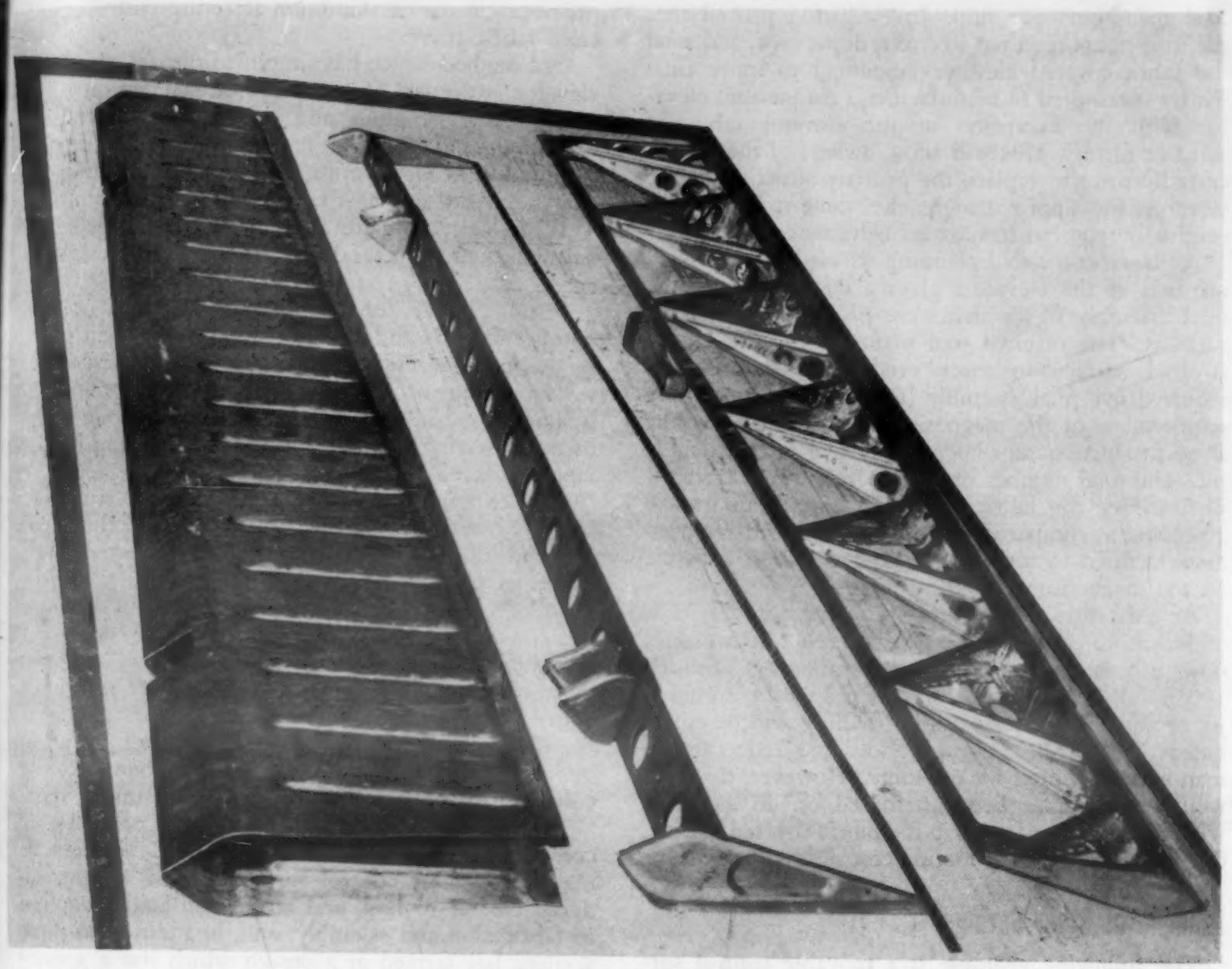
The very desirable structural properties discussed are typical also of the flap and elevator, with an even greater characteristic shown in the magnesium flap which tested to 400% ultimate design load. But, as in the aileron, since all detail parts were of minimum material gage, no additional weight could be saved. A comparison of the weights of the three control surfaces shows a saving of 6.0 lb. over the fabric-covered surfaces.

The new aileron surface supports 210% of limit design load.

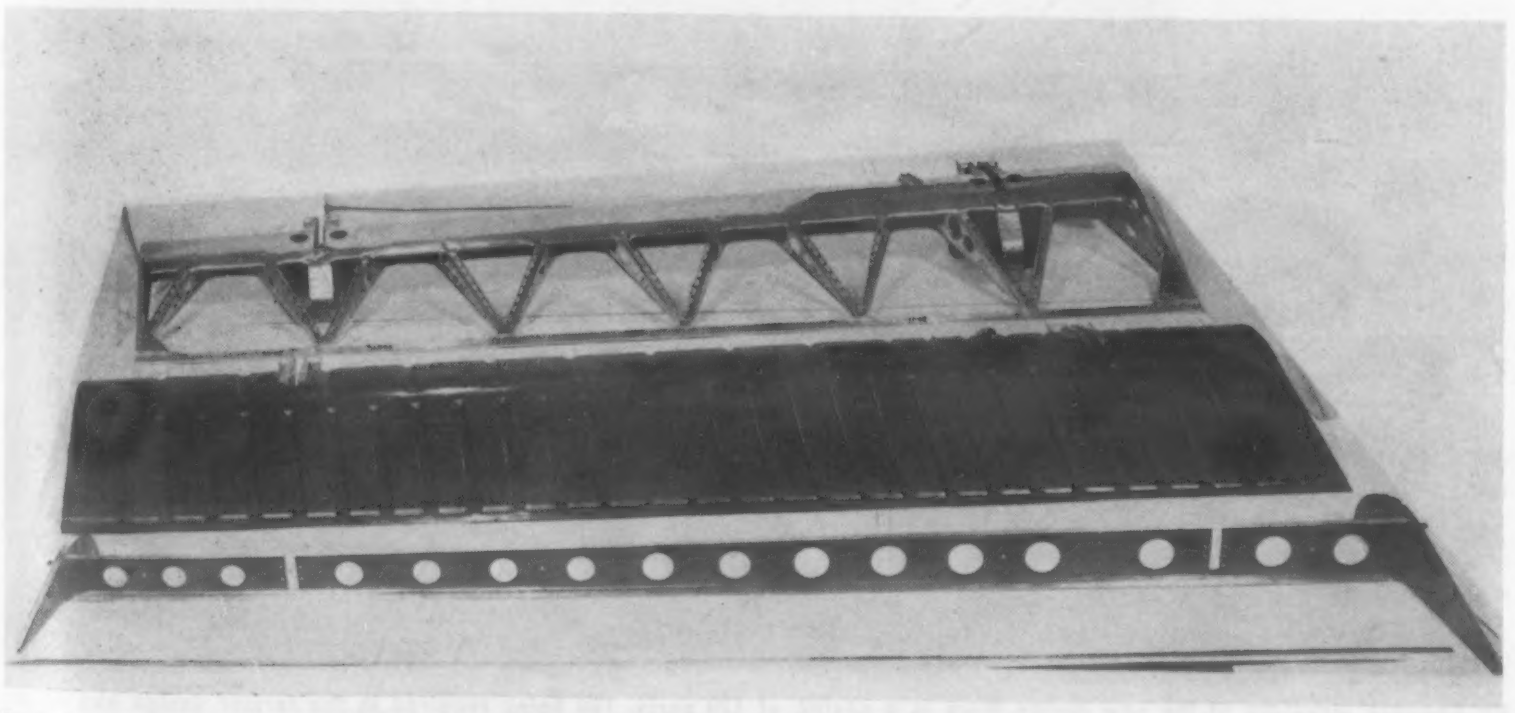
Control Surface	*Fabric-Covered Surface*	*Magnesium Surface*	*Saving in Weight/Ship*
Flaps	21.4 lb.	17.4 lb.	4.0 lb.
Ailerons	16.4 lb.	16.4 lb.	— lb.
Elevators	16.4 lb.	14.4 lb.	2.0 lb.
		Total	6.0 lb.

The saving in weight by the use of magnesium alloy for the primary structure is magnified due to the necessary static balance required on the aileron. The present magnesium alloy aileron requires 2.8 lb. of lead to static balance the surface. If this surface were designed of aluminum alloy using the same gages of material, a balance weight of 4.6 lb. would be required. This added to the increase in weight of the primary structure of aluminum alloy would be an increase of 3.8 lb. per aileron, or an increase of 7.6 lb. per ship. A reduction of material gage through the use of aluminum alloy would be prohibitive due to the sheet width required. Not requiring a static balance, it would be possible to convert the flaps from magnesium alloy to aluminum alloy with a minimum loss of weight. Assuming that 0.020 24ST aluminum alloy would replace the 0.025 FS-1H magnesium alloy from a strength viewpoint, increase in weight would amount to 4.0 lb.

Not to be considered secondary is the saving in man-hours of fabrication, assembly and tooling which has been achieved by the design of magnesium control surfaces. The quantity of fabric-covered surfaces manufactured was so small that a true comparison through time study and accumulated tooling cost could not be accomplished. The fabric-covered surfaces were never tooled for production. However, through estimated fabrication time, assembly time and tooling cost a rough comparison has been made. The saving in man-hours of manufacturing time of the magnesium elevator over the fabric-covered elevator amounted to 10.75 man-hours per assembly, or



The reduction in necessary parts between former and present flaps is shown here. The new assembly (center and left) requires very little ribbing.



Simplicity of design and construction of an aileron can be seen here by comparing the new (foreground) with the old.

21.5 man-hours per ship. Investigation proved that the man-hours required to cover, dope, tape, and sand the fabric-covered elevator amounted to more time than was required to manufacture a magnesium elevator with the exception of the elevator tab, and actuator fitting. This will allow owners of the Beechcraft Bonanza to replace the primary structure of the elevator for approximately the same cost as was originally required to have an elevator covered.

A glance at the tool planning which was completed on each of the elevators gives a comparison of the final assembly jigs which were planned for the two surfaces. The original tool planning for the fabric-covered surface to meet production requirements required five final assembly jigs, whereas the tooling requirement of the magnesium elevator to meet the same production schedule is only one final assembly jig. The total number of tools which were originally planned for the fabric-covered surface amounted to 102 tools, as compared with 45 tools which have been manufactured to meet the same production schedule on the magnesium elevator.

At this time a tooling improvement program is underway to eliminate the final assembly jig which is now in use on the magnesium aileron. Through 100% full hole coordination the use of the assembly jig to align the detail parts for drilling will be eliminated. This will mean an additional reduction in man-hours required for assembly. However, this step would never have been attempted on an assembly with the number of parts in the fabric-covered aileron, due to the tremendous tooling cost necessary.

Example of Other Savings

The following example is a movable control surface, which is being made of magnesium and was previously made of aluminum structure with a coped cloth fabric cover.

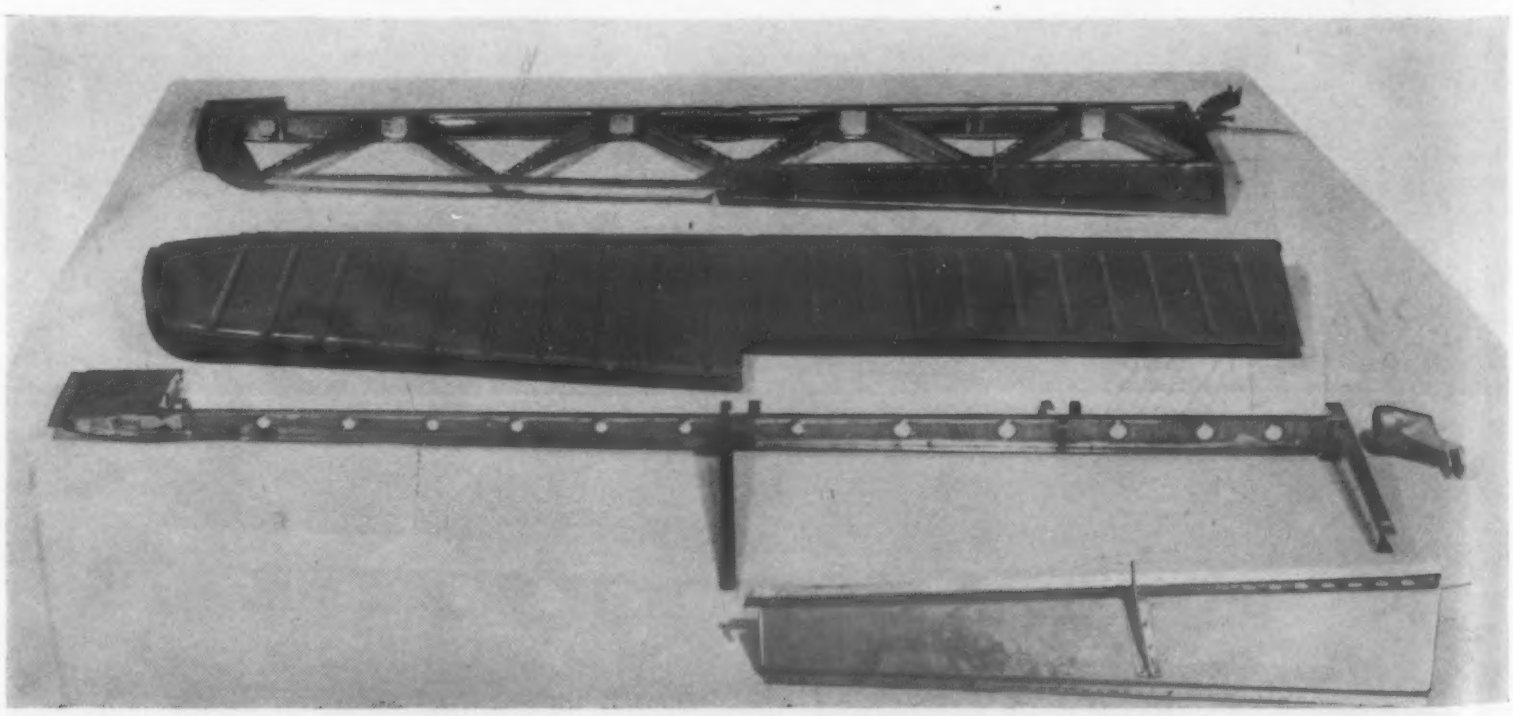
One method which has simplified the design of this elevator is the use of one piece of magnesium sheet taking three bendings and one forming operation. Concaved beading of the magnesium sheet is accomplished in the one forming operation. This gives your skin covering and at the same time adds stiffness. This method eliminates a large per cent of the internal aluminum structural members, such as ribs, stiffeners, etc.

In our former design it was necessary to build a number of tools and dies to make all the small parts. Now we have replaced these with a few large dies with a saving in overall cost. Spot welding the magnesium skin trailing edge has eliminated man-hours used for sewing, taping, doping and painting of the fabric surface.

This elimination of small parts has allotted more space in our stock room and greatly reduced the paper work in all departments, such as separately detailed drawings, etc.

Labor cost on the former fabric covered elevator was considerable, but is not obtainable due to the fact it did not warrant production preparation and was replaced by our magnesium design. The saving of man-hours, especially in inspection, assembly and installation operations, was the governing factor in our change in material and methods; therefore, the cost comparison of each material was a minor item.

In summation, the Beech Aircraft Corp. has, in converting from fabric-covered control surfaces to magnesium alloy control surfaces, saved weight, reduced cost of tooling, and saved man-hours required in fabrication and assembly; and, in addition to these savings, has arrived at a design which has a greater strength-weight ratio and reduced ultimate deflections.



On Bonanza elevators of the new design there is a saving of 120 parts, 154 being required in the former design and 34 in today's.

23% saving in deadweight; increased strength; and improved stability have been achieved at Fruehauf Trailer Co. in trailer door frames using all-welded steel frame construction instead of conventional wood-frame doors. Production of Fruehauf-all-metal doors begins in this corner of the department where a battery of automatic spot-welders—especially designed for the work by Progressive Welder Co.—weld pre-cut steel angles into the basic door frames.

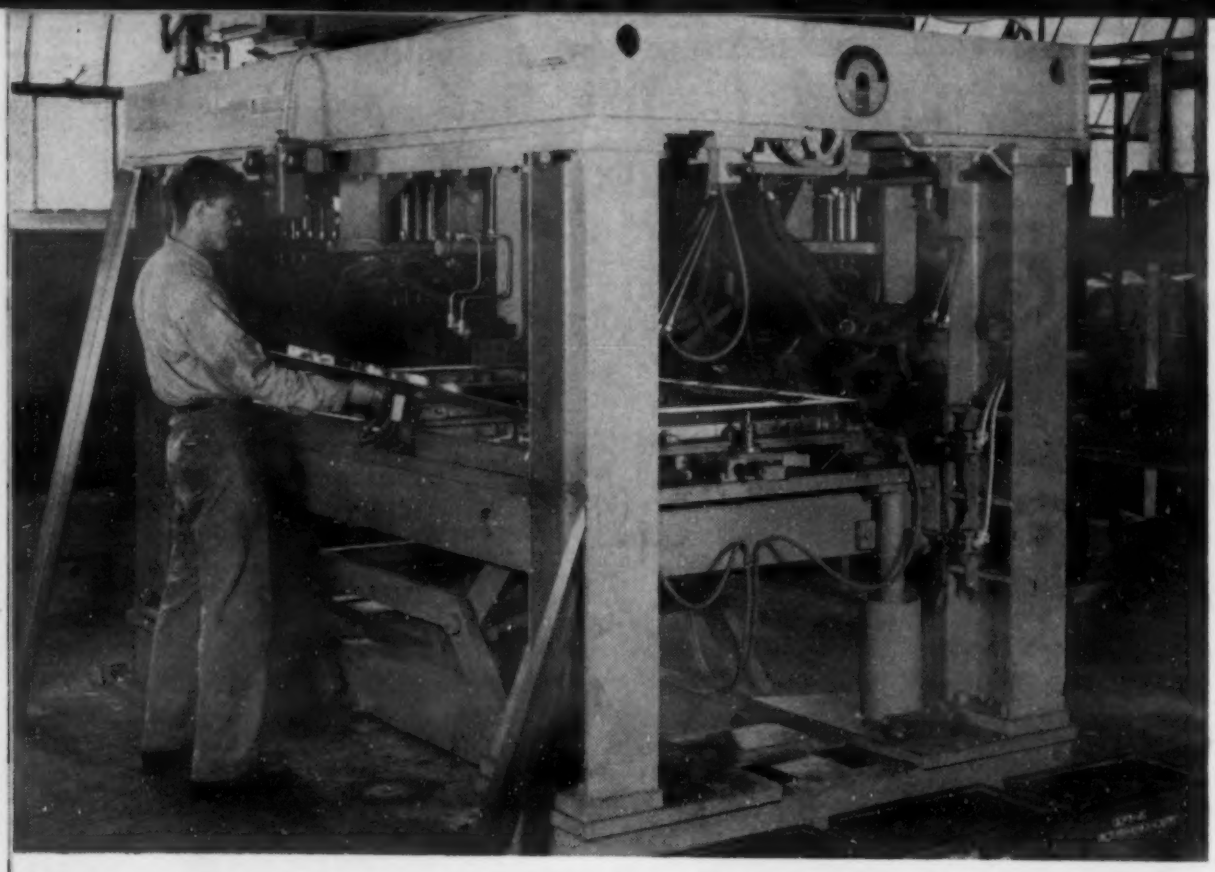
Welding Steel Trailer Door Frames Increases Strength, Saves Weight

by ATHEL F. DENHAM

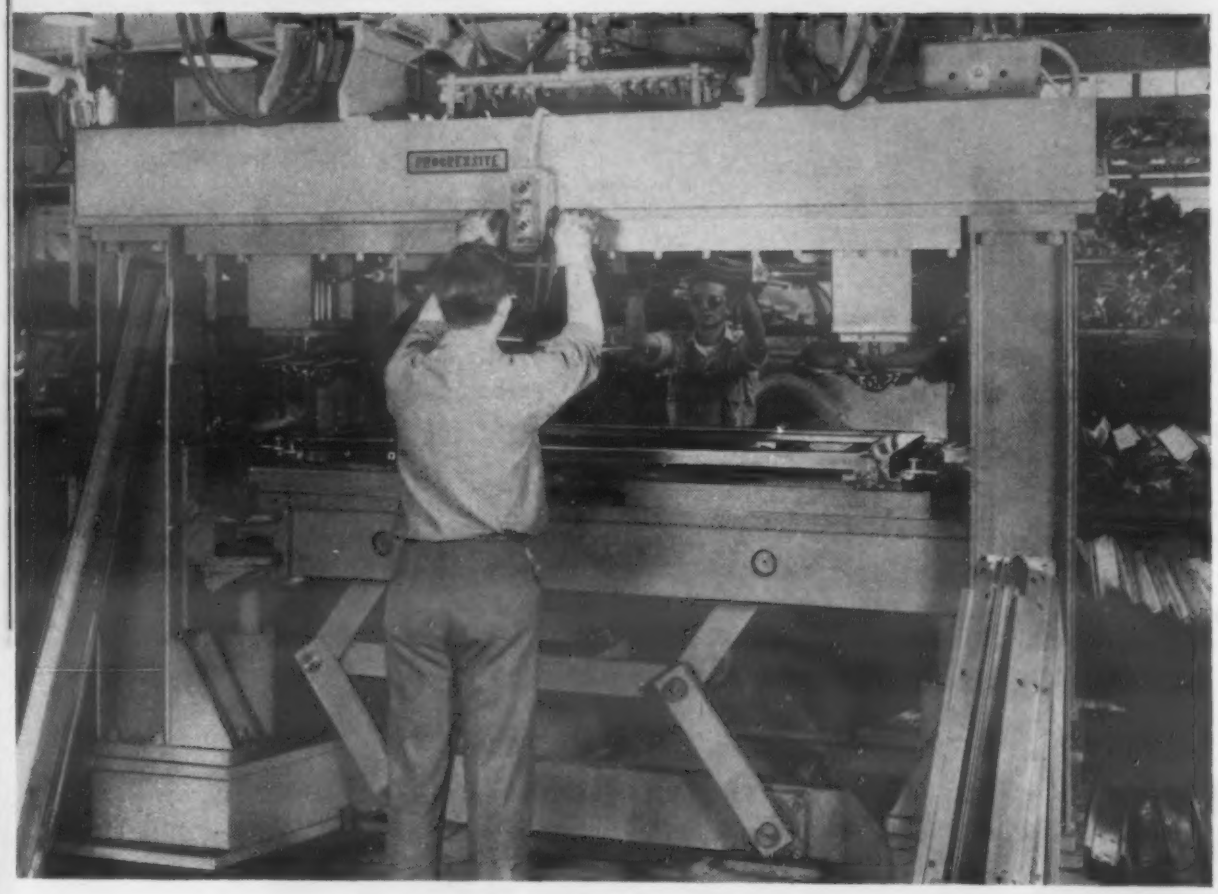
A change-over from wood-frame doors to all-steel doors of welded construction resulted in a 23% reduction in deadweight of trailers. Automatic spot-welding equipment resulted in a great increase in output. This pictorial story shows the methods employed in mass-producing such door-frames.

A COMBINATION OF DESIGN AND PROCESS ENGINEERING to enable the use of automatic resistance welding in the fabrication of trailer doors has enabled Fruehauf Trailer Co. to achieve:

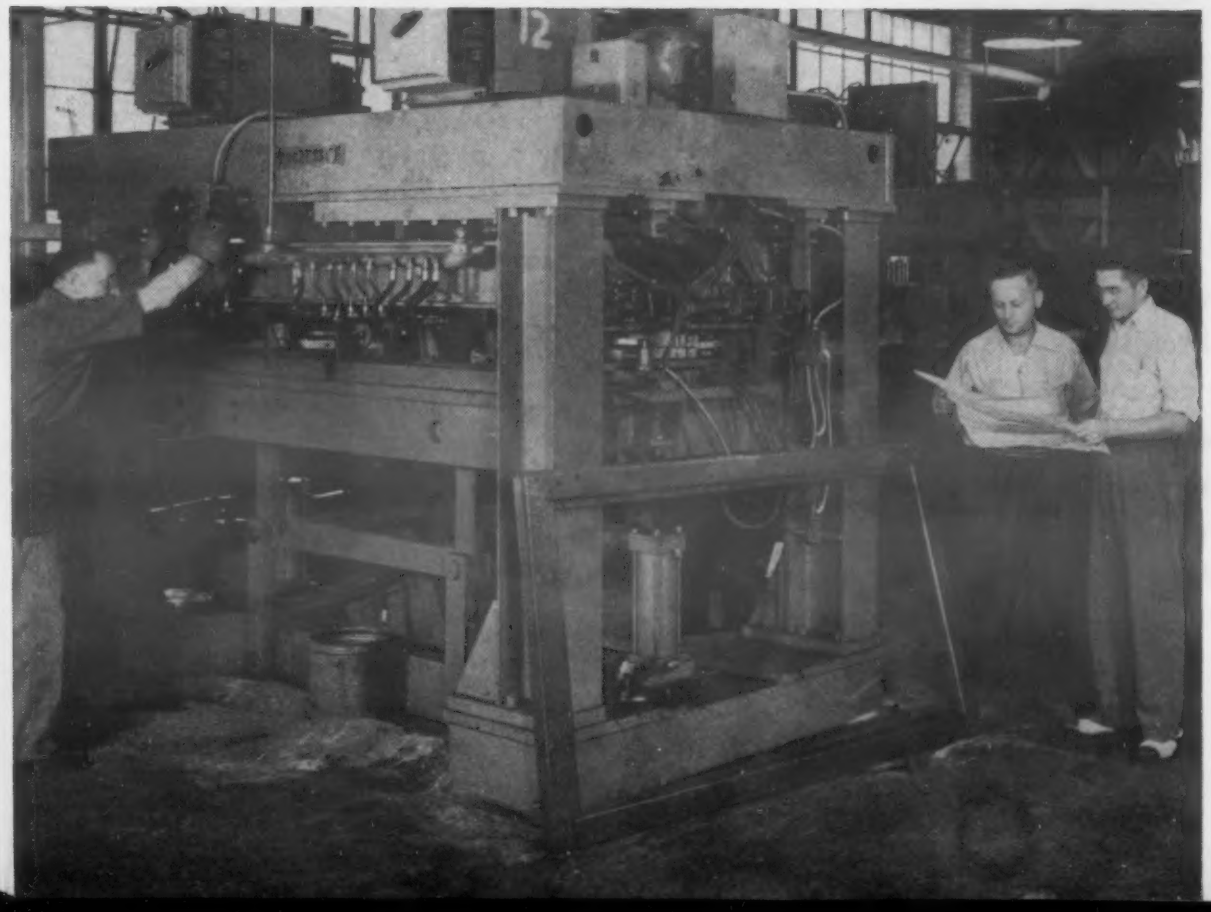
1. A 23% reduction in weight of door frames—reflected in increased payload capacity of truck trailers.
2. An inherently stronger door construction; not subject to warping, etc., under changing atmospheric conditions.
3. Reduction in floor space required for door fabrication.
4. Increased output of doors per man-hour and



On this Progressive "Ultra-Speed" welder, five pre-cut steel angles are welded together with 64 spot welds—in 16 sec.—to form the outside section of the door frame. Here, one of the machine's two operators is placing a steel angle on the adjustable (for different door sizes) table.



The inside section of the door frame is formed on this welder by joining four steel angles together with 36 spot welds. Here, the angles have already been clamped into place. Each operator must raise both hands and press two of four starting buttons simultaneously to start the machines, as a safety precaution.



The inside and outside door frame sections are united on the third Progressive "Ultra-Speed" with up to 68 edge welds, depending on door size. Here, work table has been raised to welding position. After the 16-sec. welding cycle is completed, the work table is lowered automatically for unloading and reloading.

Assembled door frames are clamped on turntable stands and six frame-stiffening channels are welded in place with Progressive hand-operated portable welding guns. These guns are counter-balanced for ease of operation to reduce operator fatigue.

machine-hour without requiring increased effort on the part of the operator.

5. Changing what formerly was a bottleneck in trailer production to an operation in which there is considerable reserve capacity for increased production without requiring further equipment.

All of this has been achieved—insofar as new manufacturing equipment is concerned—through the development of three "universal" type automatic spot welding machines to assemble the basic framework supplemented by a turntable type fixture at which various brackets are attached with portable welding guns.

All of the equipment was designed by the Process Engineering Dept. of Progressive Welder Co., Detroit, in collaboration with Fruehauf engineers. Machines, guns and fixtures were also produced by Progressive.

Approximately 250 spot welds are made in fabricating the new stronger Freuhauf trailer doors. However, of these welds, some 168 are made automatically in three Progressive Ultra-Speed multiple spot welding machines. It is these three machines—which can interchangeably weld a wide variety of sizes and types of door frames—which have been largely responsible for converting a bottle-neck into a "line-pacer." As a matter of fact, these three machines actually have 100% reserve capacity, based on "normal" trailer production. Thus, the equipment provides amply for Freuhauf's current trailer production expansion program.

Door frame stock—in the form of pre-cut steel angles—is of No. 20 USS gage, hot-rolled, pickled, and oiled mild steel. The first Ultra-Speed welder joins five of these pre-cut rails with 64 spot welds to form the outside section of the door frame. Four small reinforcing sections are also welded in this operation, one in each corner. The second machine, making 36 welds in rapid sequence, joins four similarly formed rails to make the inside door frame. Inside and outside frame sections are united on the third Ultra-Speed welder which makes a maximum of 68 edge-welds. The exact number of welds in the latter instance, of course, depends on the size of the door.

Leaving the Ultra-Speed machines, the assemblies are clamped on turntable stands and six frame-stiffening channels and latch mounting plates are welded in place with portable welding gun units. These guns are all counter-balanced for ease of handling to decrease operator fatigue.

The three Progressive Ultra-Speed welding ma-

A pair of the new stronger all-resistance-welded doors weigh only 156 lb. as compared with 205 lb. formerly.

chines are similar in construction. The operating cycle of each machine—from the time the "start" buttons are pushed until the machine automatically returns to the unloading position—is only 16 sec.

"Heart" of these welders is the "Ultra-Speed" current distributor. This unit permits all of the welding points to engage the work simultaneously under welding pressure. The electrodes thus act as clamps and help compensate for any possible variation in the shape of the parts to be welded together. Spot welds are made in pairs (series welding) and each machine is capable of producing 60 welded assemblies per hr.

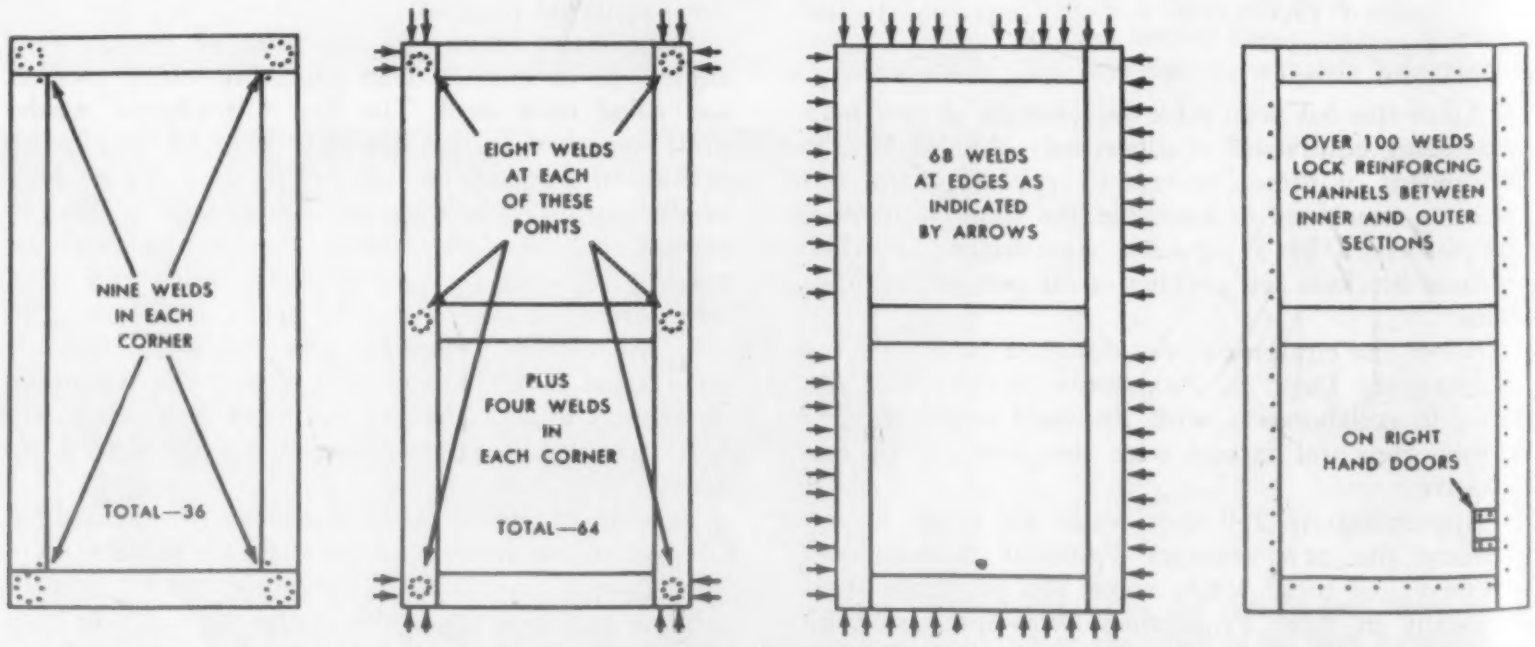
Each welder is equipped with two 75-kva. welding transformers, and a self-contained motor-driven hydraulic power unit which supplies both clamping and welding pressure to the hydraulic welding guns. This equipment is built into an air operated vertical press. Toggles raise and securely lock the press bed in the upper—or "welding"—position. They lower the press bed for unloading and reloading.

An unusually high degree of universality—for automatic machines—has been engineered into the Ultra-Speed machines. They are designed to handle all the different parts required for making right, left, and side doors of many different sizes. To do this both the welding dies and gun carriers on the first two machines are fully adjustable by means of hand cranks operating lead screws. Spring loaded locking pins locate and lock the dies and gun carriers in the required position for a given type and size of door. In the third machine, only the welding die requires adjusting. The welding guns are fixed. Sufficient guns are provided to accommodate the longest door. For smaller doors, the excess guns are cut out by hand-operated hydraulic valves.

Only two operators are required for each of the three Ultra-Speed welders. For safety, each operator must raise both his hands and press two of the four interlocked starting buttons simultaneously to start the machine.

Plant layout is such that the steel angles are delivered to one end of the welding department, while finish welded doors are trucked away from the other end. Less floor space is required to produce an equal number of door frames.

Due to this experience with "Ultra-Speed" welding, Fruehauf reports that they intend to extend automatic resistance welding to other operations in the near future.



Sketches showing the 3 automatic spot-welding operations on Fruehauf trailer door frames and (at right) single spot welds made with portable guns.

For many uses, additional protection must be provided for tinplate to guard against staining and rusting. The Protectatin process is a simple method of coating tinplate and can be applied to the plate before forming.

A Protective Filming Process for Tinplate

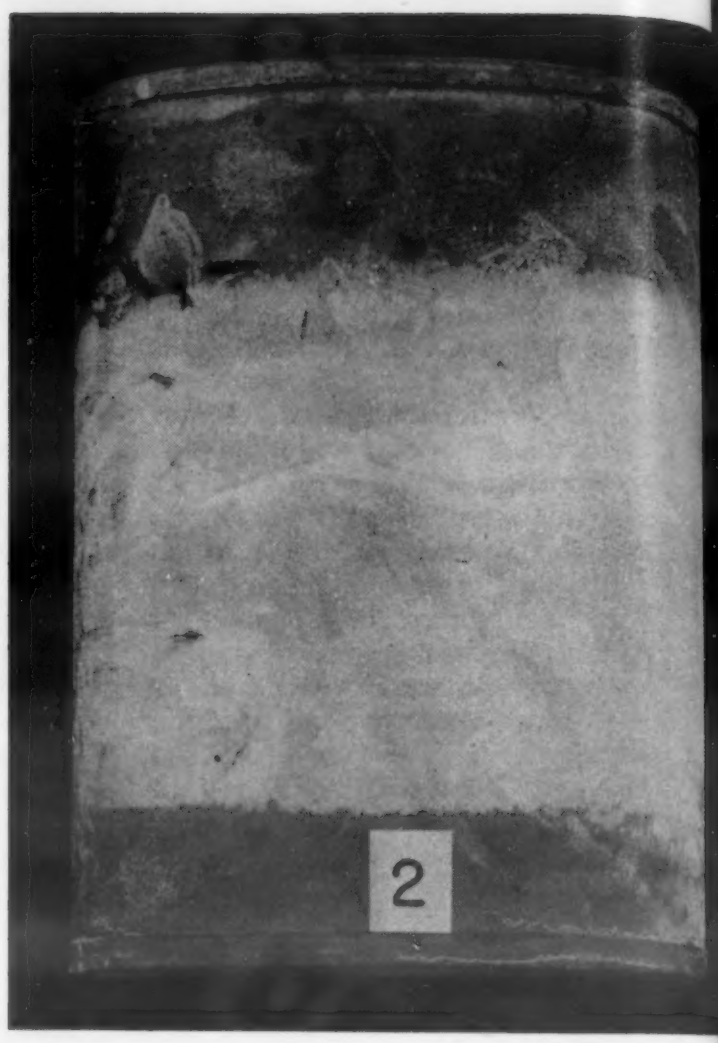
by **H. R. CLAUSER,** *Associate Editor,* MATERIALS & METHODS

ALTHOUGH TINPLATE NORMALLY PROVIDES good protection against rusting under dry conditions, its rust resistance is considerably reduced where humid or moist conditions are encountered. Also, tinplate in cans holding sulfur-containing foodstuffs has a tendency to form an unsightly black stain of iron sulfide.

As early as 1940 the Tin Research Institute in England began development work on a practical means of producing a protective film on tinplate to overcome these difficulties. Later, Battelle Memorial Institute in this country assisted in the program. The process, known as Protectatin, has now been developed to the point where a thin, invisible oxide film can be produced on tinplate in 20 sec. or less. It consists of simply dipping the tinplate in a hot alkaline phosphate-dichromate solution containing a suitable wetting or penetrating agent. The resulting film protects the tinplate from sulfur staining, greatly retards rusting in moist air, and provides a good base for paint on very thin electro-tinned plate.

The exact nature or mechanism of the protection provided by the film is not definitely known. Treatment of uncoated steel is comparatively ineffective. The film is colorless and invisible and normally gives the tinplate a bright shiny appearance. An important feature of the process is that the bath is an active degreasing agent and therefore on hot-dipped tinplate no preliminary degreasing is necessary, since the treatment does all necessary cleaning.

Untreated, salt spray



Treated, salt spray

Fig. 1—The Protectatin process increases corrosion resistance of tin cans. Here shown are treated a[illegible] reated

The Solution and Procedure

The composition of solution is as follows:

	Lb. Per 100 Gal.	*Grams Per Liter*
Crystalline trisodium phosphate	20	24
(or anhydrous trisodium phosphate)	(9)	(10.8)
Sodium dichromate	8	9.6
Sodium hydroxide	22	26.4
Wetting agent	3	3.5

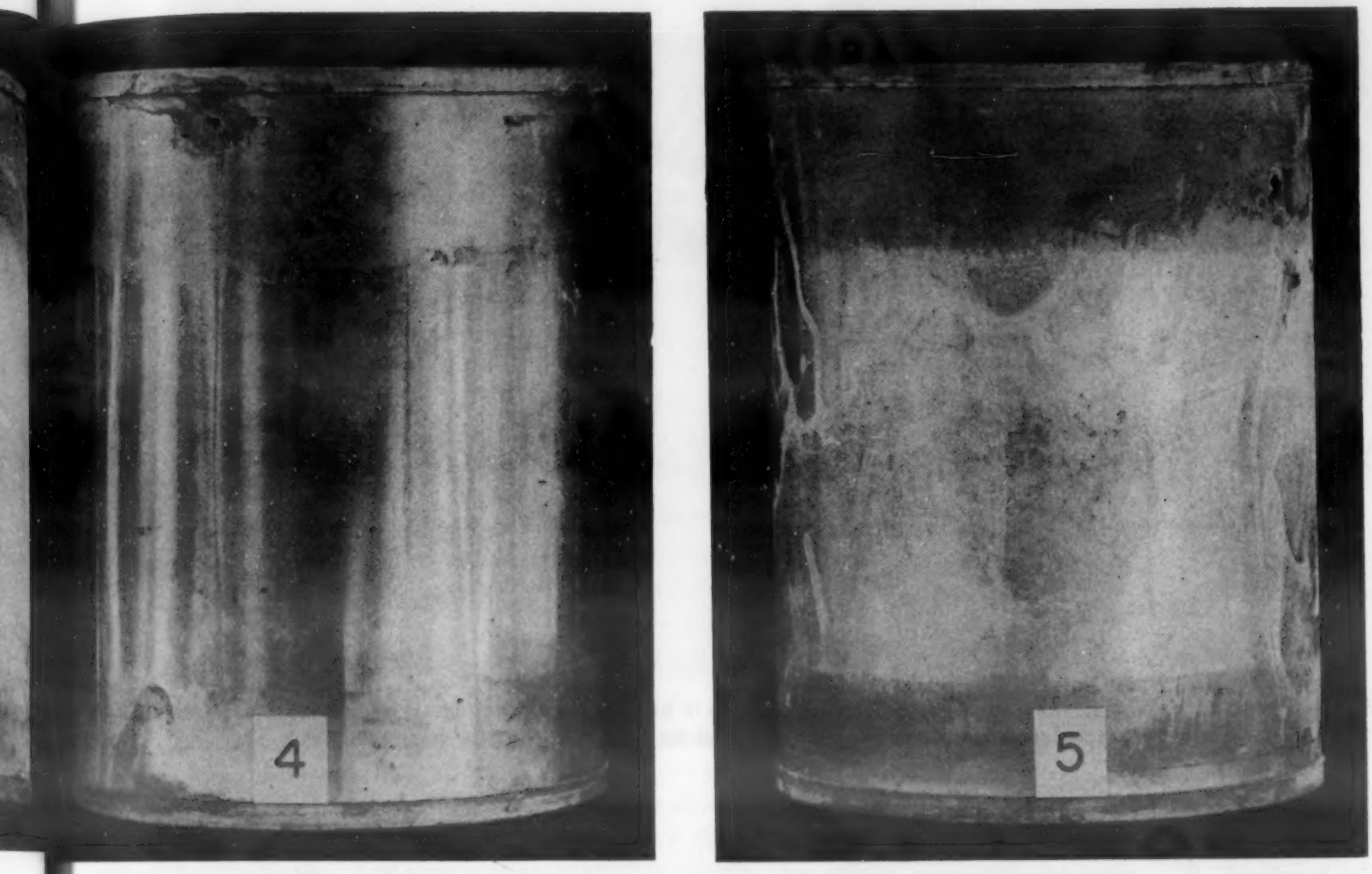
The wetting agent is an important constituent of the bath. It improves the detergent properties of the solution and aids it to wet the greasy tinplate surface, thus allowing the filming to proceed more quickly. Wetting agents such as Drysonol ME dry or Merpol B (E. I. du Pont de Nemours & Co.) and Tergitol 4 (Carbide & Carbon Chemical Co.) have proved satisfactory in this alkaline solution. A brighter surface is usually obtained with Tergitol 4. Rain water or distilled water is preferable for making the solution.

During the filming process, the temperature of the solution should be kept as high as possible within the range of 140 to 185 F. With brush-type washers, a single pass through the machine, taking about 2 sec., is sufficient. Where simple dipping is used, the immersion time should be not less than 10 sec. at 185 F to 20 sec. at 140 F. The time of treatment, within this range, will vary according to the type washer.

Maximum corrosion resistance results by air-drying without washing. Generally, however, the tinplate is washed immediately. When treating the interior of cans, or tinplate which may later contact food, thorough washing to remove adhering soluble salts is essential. A brighter finish is also obtained by rinsing immediately after the treatment.

Any conventional washing tank arrangement may be used to process the tinplate. Steel tanks, however, are not suitable unless precautions are taken to prevent contact between the tinplate and the steel. If the tinplate should touch the steel tank, etching of the tin might result. Galvanized, lead-coated, tinned, or enamelled equipment is preferred. If baskets or fixtures are used during the immersion, they should be heavily coated with zinc, lead or tin.

It is possible to apply the Protectatin process to tinplate in the flat and before fabrication. Some reports indicate that the protective film can withstand deformation and abrasion during forming and fabrication without reducing the effectiveness of the film.



Untreated, humidity *Treated, humidity*

eated cans after being subjected to salt spray test for 100 hr. and humidity cabinet for 200 hr.

Others say that there is some risk of local damage to the film.

The advantages of pre-filming are obvious. The sheets are filmed on both sides simultaneously. The problem of assuring a thorough rinse of the filming solution from seams is eliminated. And protection is afforded to the plate both in transit and storage prior to fabrication.

Increasing Rust Resistance

All tinplate, whether it be hot-dipped or electro-tinned, has microscopically fine pinholes, and in general, the thinner the coating the more pinholes present. Thus, hot-dipped plate may have less than 100 per sq. in. as compared to around 1000 per sq. in. in thinner electro-tinned coatings. When tinplate in service is subjected to moisture, it will rust at these pinholes and spread. After a time, perforation of the steel will result.

There are several means of preventing rust on tinplate which have seen use on the outside of containers. One of these is applying a coating of a baked thermosetting phenolic lacquer. When this is used, a thin strip down the seams must be left uncoated for soldering and then later covered. Covering tinplate with a wax emulsion or with quick-drying lacquers have also been used.

The Protectatin process offers a simpler and less expensive method of increasing the protection provided by tin. In tests conducted in England to compare the rust resistance of cans treated by this process and lacquered cans, the treated cans stood up equally well in outdoor exposure tests and in humidity chambers that involved up to 22 days exposure. Over a very long period a lacquered can might give the best results, but seldom are cans exposed to weathering for long periods.

Although the thickness of tinplate has no effect on the protective film, the relative improvement in rust resistance is greater on thinner electro-tinned plate than on hot-dipped plate simply because there is more exposed steel to protect on more thinly coated steel.

Tests were conducted to determine the protection afforded by the Protectatin process on ½ and ¾ lb. per basis box electro-tinplate, hot-dipped plate and Terneplate. In salt water spray tests at room temperature all the panels treated by the process showed considerably less corrosion than the untreated panels after a 2-day period. At the end of 7 days the difference between the treated and untreated panels was less distinct, but still showed that the protective film

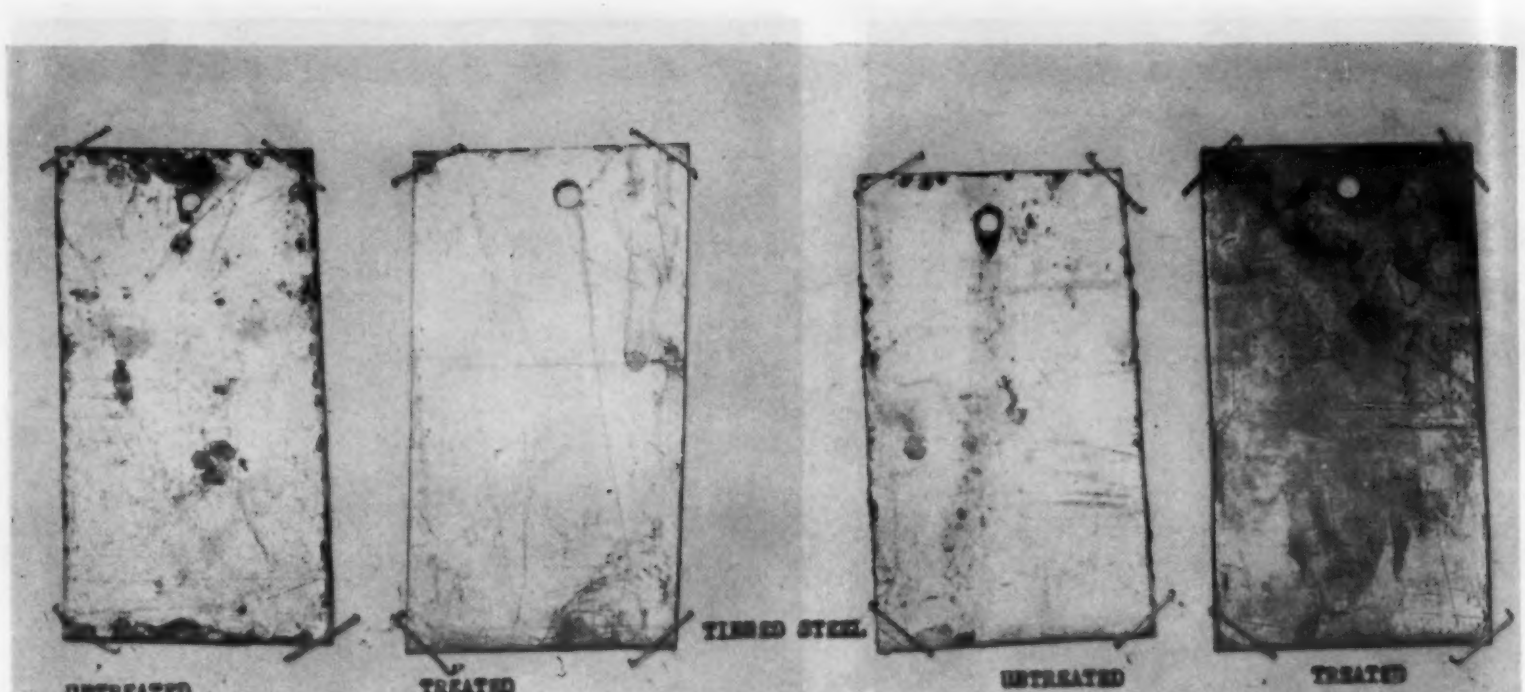


Fig. 2—Tinned panels tested for rust resistance. Untreated panels in both salt spray and steam vapor rusted considerably, while Protectatinned panels were unaffected except for slight discoloration from oxidation.

was beneficial. In outdoor exposure tests, panels and 5-gal. cans, both treated and untreated, were placed in the atmosphere for 43 days. After 8 days the treated panels showed no rust while the untreated ones showed traces. After 43 days the treated had medium rust throughout as compared to very heavy rust on the untreated panels. The results on the 5-gal. tanks were approximately the same as those reported on the panels. These tests also seemed to indicate that the protective film was least effective on Terneplate and the ½-lb. electro-tinned plate.

Preventing Sulfur Stains

When sulfur-containing foods (meats, soups, vegetables) contact tinplate, staining usually results. The staining may increase if the food remains in contact with the tin for any length of time. To avoid these difficulties, special lacquers are often applied to the inside of cans.

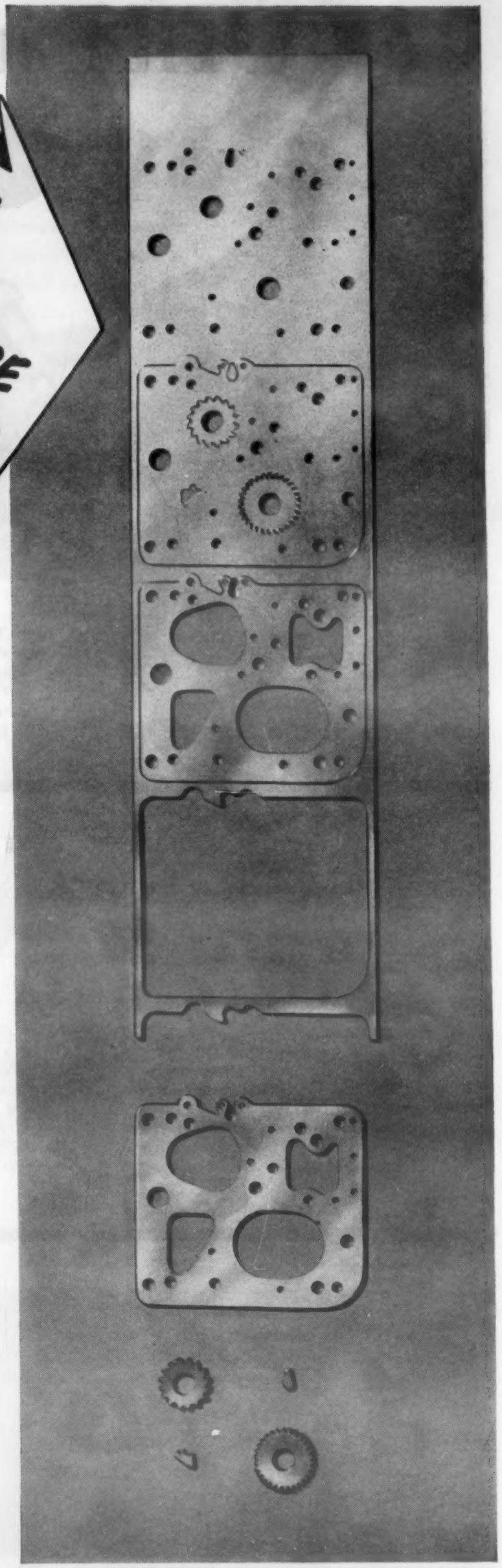
The Protectatin process has also proved useful in many applications of this kind. By dipping the tinplate in the hot alkaline phosphate-dichromate solution, adequate protection against sulfur blackening is provided. It is less expensive and simpler to apply than lacquer. However, certain precautions must be taken when used in the canning industry. If the cans are treated just before packing, the insides must be thoroughly washed to remove any residual chromate solution which could be toxic. Even this simple operation may not be feasible during the rush season of canning, and therefore the lacquer linings are often preferable in spite of their higher cost. On the other hand, if the tinplate is filmed in the flat before the cans are fabricated this washing problem is avoided. When only the outside of the container is filmed the best time for treatment appears to be after closing or just before packing for shipment.

Use as a Paint Base

In recent years the use of tinplate on steel as an undercoat for paint has received considerable attention. It has been shown that a very thin tin base improves the corrosion resistance of painted steel as well as paint adhesion. It has also been learned through tests by the Tin Research Institute that in treating tinned surfaces by the Protectatin process further improvement is achieved in the rust resistance and the adhesion of the paint. Because of this extra protection it is possible to use electro-deposited tin coatings as thin as 0.000008 in. (from alkaline tin bath) and still compare favorably with phosphating processes for preparing steel surfaces for painting. Since the tin shortage will probably prevail for some time to come, the use of the Protectatin process should be considered as a possible means of reducing the tin thickness of lacquered tin coatings presently used. For example, it may be possible to change from a thick hot-dip coating to a relatively thin electro-deposit; or the thickness of an electro-deposited coating may be reduced.

The effect of the protective film on the adhesion of lacquers used in the container industry has not been fully investigated. However, in general it is believed that treated tinplate improves the adhesion of external air-drying lacquers, has no effect on the adhesion of fruit or sulfur resisting lacquers, and impairs the adhesion of phenolic-resin meat lacquers.

CLEVER PLANNING REDUCES SCRAP— SPEEDS MANUFACTURE



THIS photograph shows progressive steps in the manufacture of a clock frame, and is an excellent example of careful planning to reduce the amount of scrap and lessen the number of operations. Note that in only a few strokes of the machine not only is a plate punched for the frame, but also a gear, a ratchet wheel, and two other small parts are produced. The work is done on a dieing machine, which operates to the very close limits that are essential in a clock. An additional item of economy is the fact that most of the other parts are made from exactly the same kind and gauge of metal, greatly simplifying purchasing, stockroom management, and production ordering.

Planning such as this is more important than ever today, when metal is scarce, and it is essential to conserve it, as well as lessen costs and speed production.

The metal used is Revere Leaded Brass, supplied to exceptionally close limits as to composition, gauge, temper, flatness, and straightness. Revere takes pride in its ability to meet these strict requirements, and will be glad to collaborate with any manufacturer in working out the application of its metals to modern, simple, accurate, metal-and-money-saving plans and processes.

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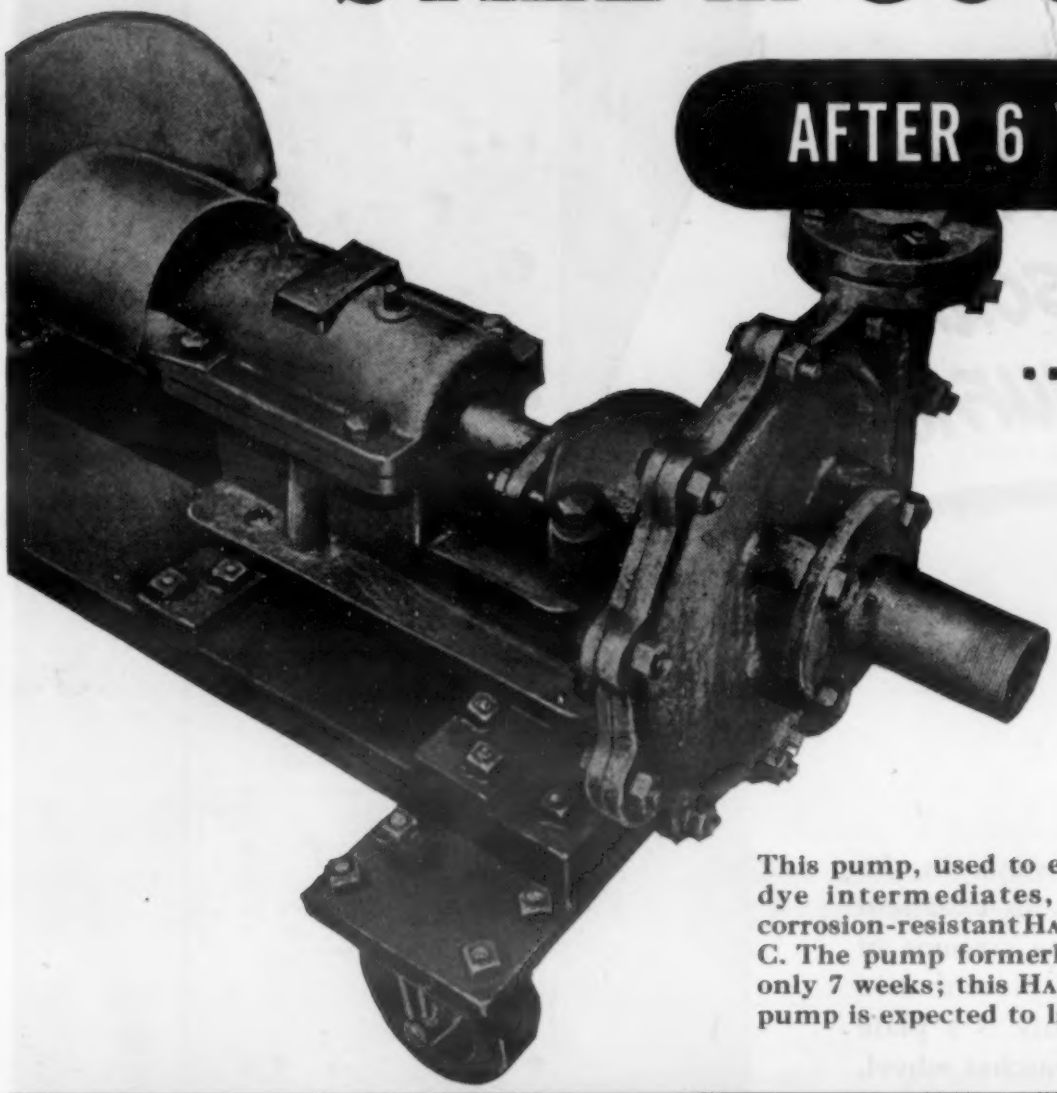
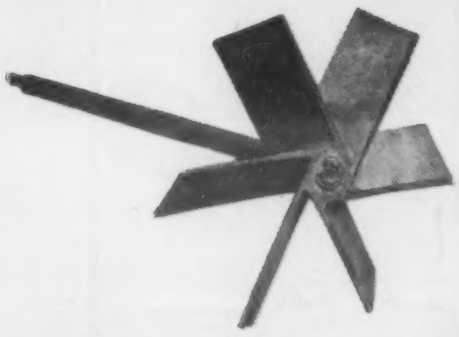


This pump, used to empty vats of dye intermediates, is made of corrosion-resistant HASTELLOY alloy C. The pump formerly used lasted only 7 weeks; this HASTELLOY alloy pump is expected to last 10 years.



HASTELLOY alloy C agitator shaft and blades are used in a reaction vat. Whip and unbalance in the agitated fluid often places considerable stress on the shaft; high-strength HASTELLOY alloy is not affected by this stress.

This steam jet of cast HASTELLOY alloy C is also used in a reaction vat. After 6 years service in acids, alkalies, and strong oxidizing agents, the jet is still in good operating condition.

Write for the booklet "HASTELLOY High-Strength Nickel-Base Corrosion-Resistant Alloys" for information on available forms and methods of fabrication.

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MATERIALS & METHODS MANUAL

29

This is another in a series of Manuals on engineering materials and processing methods, published at periodic intervals as special sections in Materials & Methods. Each of them is intended to be a compressed handbook on its particular subject and to be packed with useful reference data on the characteristics of certain materials or metal forms or with essential principles, best procedures and operating data for performing specific metalworking processes.

Screw Machine Products

by T. C. Du Mond, Managing Editor,
MATERIALS & METHODS

When you are considering the manufacture of a small part it is wise first to evaluate its applicability to production by automatic screw machine. There are relatively few limitations on screw machine products if their design conforms to a few basic specifications. An important consideration in selecting screw machine products is the wide range of materials in which such parts can be furnished. In this manual will be found general advantages and limitations applying to parts formed by screw machine, design considerations, information on useable materials and a special section on Swiss automatic products.

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Materials & Methods, August 1947
(Published since 1929 as Metals and Alloys)

Threaded aluminum rings are produced from rods at the rate of 1500 per hr. to an accuracy of 0.007 in. on this automatic screw machine. (Courtesy: Westinghouse Electric Corp.)

Introduction

Although lathes of one sort or another have been in use for centuries it was not until something over 70 years ago that a major refinement of the lathe came into being. The early function of the new variety of lathe gave it the name it still bears—the screw machine. Since its development, the screw machine has been responsible for an ever increasing flow of products of assorted sizes and contours.

Basically, the automatic screw machine of today is a miniature turret lathe with a hollow spindle through which bar stock is fed to be worked on by the various cutting tools carried in the turret and by those on the tool slides. Control is provided over the turret so that at the proper instant the desired tool is fed into the work, kept there until its task is performed and then withdrawn. In the past such control has been exercised largely through cams, individually cut for each job, but newer machines provide quadrant linkage to obtain the same identical results.

There are really four different types of screw machines. Hand screw ma-

chines, really vary little from turret athes except that they feed through he spindle and are designed to handle maller work. Then there is the single pindle automatic screw machine. Designed for even smaller work than the American screw machine is the Swiss-ype automatic which differs considerably in operation from the machines leveloped here. Finally, there are the multiple-spindle automatics, which ome with 2, 4, 5, 6 or 8 spindles. Since the Swiss-type machines are omewhat less versatile without special ttachments than other automatic screw machines, their products will be described in a special section of this report. The main portion of this manual will, therefore, concern itself with the more universal types of machines.

Limitations

There are two serious limitations which must be met if a product is to be turned out on automatic screw machines. Most important is the requirement that the all machining must be on surfaces of rotation which are concentric with the part's axis. Second is the matter of size. Single spindle machines (not any one machine) can handle parts ranging in diameter from ¼ to 8 in. and up to 8 in. in length. A special model recently designed will take diameters slightly over 10 in. The majority of machines, however, are furnished in one of two sizes, namely those taking up to 2½-in. dia. stock and those for diameters of 1-in. and less, with a length limit of about 6 in. Although multiple spindle machines, of certain types, can handle stock up to 5-in. dia. and in 20-in. lengths, those generally in use have limits of 2⅝-in. and 6-in. respectively on diameter and length.

Although screw machines were designed to produce screws and bolts and other threaded parts, their use is by no means limited to such products. It is quite likely that many screw machines in use today have never produced either a screw or a bolt, if indeed they have ever cut a thread.

Parts produced on screw machines, in addition to the already mentioned screws and bolts, include bushings, bearings and bearing parts, pins, washers, nuts, and thousands of different parts of special and peculiar design. All parts have in common the requirement of having produced on them surfaces of rotation concentric with the axis of the stock being turned. Standard screw machines are designed to do turning, drilling, boring, threading, forming, facing, cutting-off and burnishing. With attachments they can also do slotting, milling and cross-drilling.

Screw machines can be used to produce parts from practically any material that is machinable by other commonly used machining methods. Such materials include most types of iron and steel, copper alloys, aluminum and magnesium alloys, nickel-base alloys, noble metals, zinc and plastics.

The principal reasons for the use of screw machines are the speed and high accuracy in repetitive operations. On certain types of parts production of as high as 4,000 parts per hour can be maintained. At the same time, tolerances of 0.001 to 0.003 in. are easily maintained.

If the part is right, there is really no serious competitive method to the screw machine, since it provides a much greater latitude in materials than any production method which might be considered for the parts. Too, the finish is high and the production great. The most serious charge against producing parts via screw machine is that scrap losses are high due to the fact that the bar stock used must be slightly larger in diameter than the largest cross-section of the part. With some materials this is neither a serious nor an expensive factor, but with other materials it might swing the decision to another method of production.

Design Considerations

Before considering whether or not a product should be assigned to a screw machine for manufacture it is wise to determine how many are to be needed. If the quantity is less than 1,000 pieces, it might be well to consider some other method, for 1,000 has been determined as the minimum number of pieces required to make the process economical. When quantities are less than 1,000 hand screw machines might prove satisfactory. When quantities reach 50,000 or more, multiple-spindle automatics are indicated.

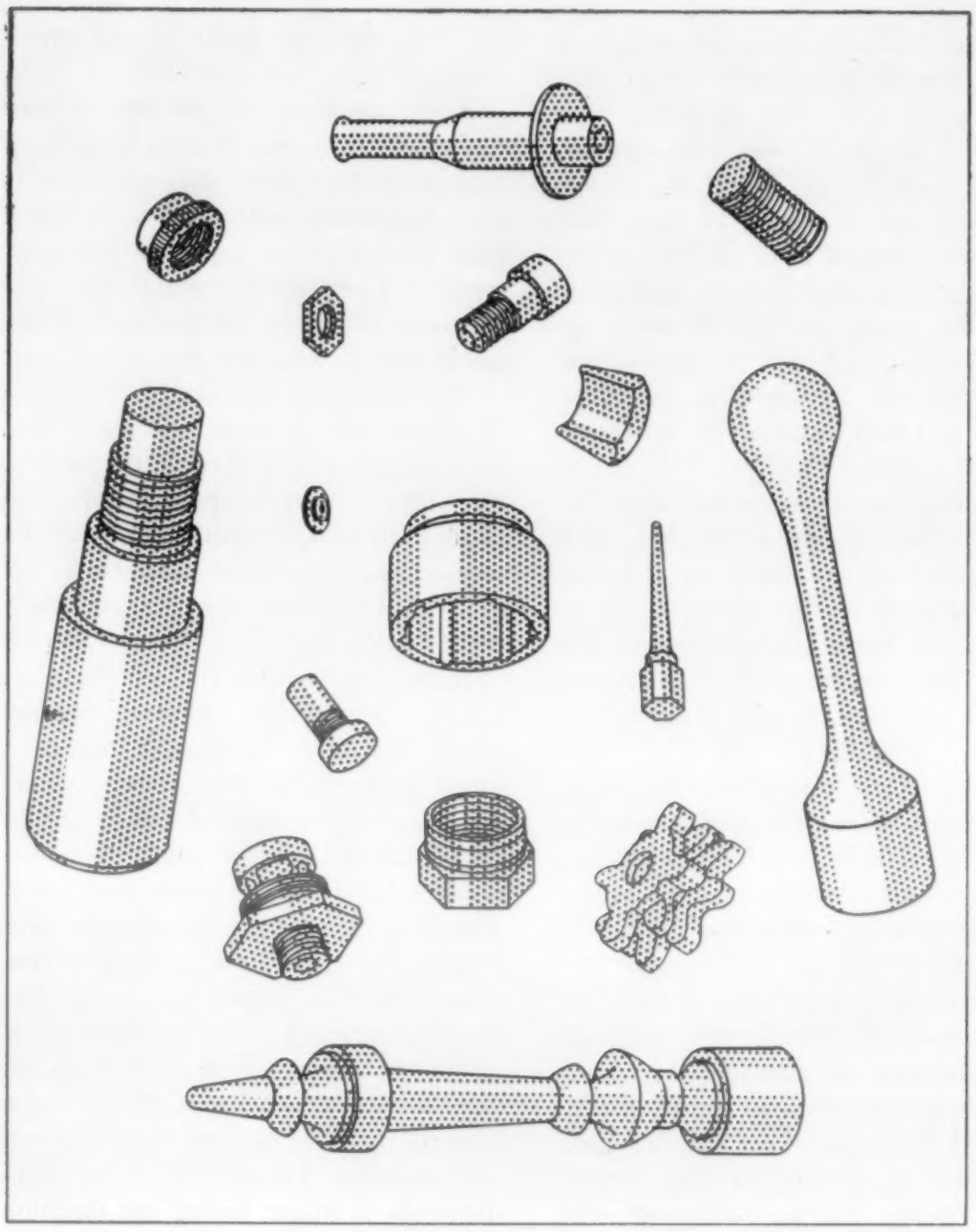
The type of machine selected has a bearing on the size part which can be handled. Single spindle machines can handle work with diameters of from ¼ to 8 in., length of part is limited to 8 in. except for special machines which can handle a part 10½-in. long. Single spindle machines are most commonly provided in two classes, one limited to parts having a maximum diameter of 2½-in., and the other having a top capacity of 1-in. dia. With both classes length is limited to 6 in..

Multiple-spindle machines can take bars up to 5-in. dia. and in lengths up to 20 in., but the most common multiple-spindle automatics have top limits of 2⅝-in. dia. and 6-in. length.

There are a few design points which, if followed wherever feasible, can simplify production of screw-machine parts and help to keep costs way down.

Holes

For instance, a designer might specify that a hole in the part must have a square bottom. This requirement can be met only with special tools. If there is no functional reason for a square-bottom hole, a standard drill can be used. Standard drills leave a conical recess at the bottom of the hole. Perhaps a compromise can be reached between a square-bottom hole and a re-



Pieces shown here are typical of the various products regularly turned out by automatic screw machines. Such work is common to most screw machine shops.

cessed hole, by providing just a little relief.

By using several different turret stations in the operation, holes up to 10 times their diameter can be drilled. Holes as deep as 5 times the diameter have been drilled in one operation.

In providing for holes that are to be tapped subsequently it is important that sufficient clearance be left for taps. Bottoming taps require a clearance of the equivalent of three complete threads, while five thread clearance is needed for other types of taps.

Corners

As in any machining operation the achievement of square corners anywhere on the part being produced is rather difficult and often expensive. This is particularly true of square external shoulders which should be avoided unless absolutely necessary. A slight radius—at least 0.005 in.—should be provided for. Too, chamfers are preferred over round corners. They are much easier to achieve and for most purposes serve equally well.

Chamfers, likewise are desirable at both ends of threads tapped to a shoulder or close to the bottom of a hole. The chamfers should be about 45 deg.

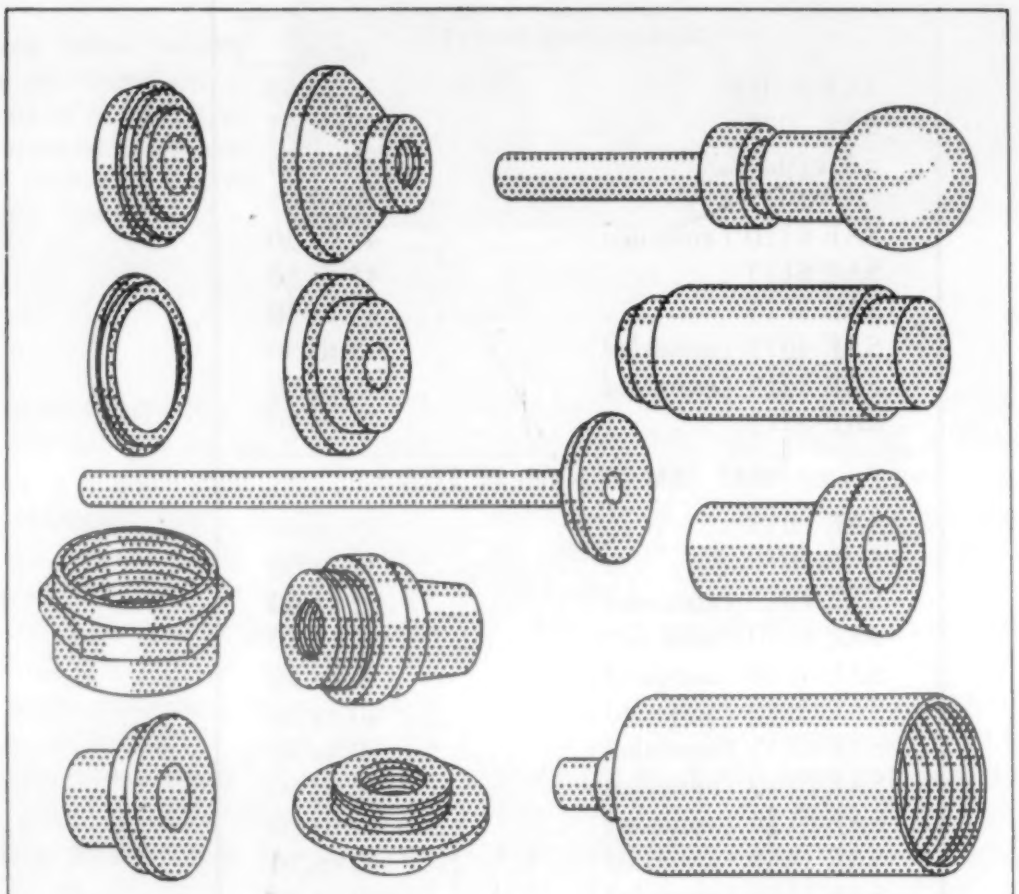
Shapes

If the part is small and the form simple, there is always a possibility of producing it by means of a single form tool. In these cases the length should be less than three times the smallest final diameter. This limitation holds because the stock is supported only at the collet. Lengths greater than recommended might result in excessive breakage and would certainly make difficult the holding of accurate dimensions.

Threads

Screw machine parts may be threaded all over or may have no threads at all. When external threads are desired on a part which must screw tightly into another part, it is advisable to leave a

Screw Machine Products



These parts are illustrative of products which can be made on the larger sizes of automatic screw machines. Drawings on these two pages are rendered from photographs furnished by Brown & Sharpe Mfg. Co.

clearance of at least 2½ threads. The tight fit can be achieved by a slight undercut on the neck of the part back of the thread.

Design Do's

Machine only those surfaces where machining is necessary. Any superfluous machining adds to costs.

So design the piece that it can be produced from a standard size of stock. Unnecessarily generous allowances can result in excessive scrap losses.

All other factors being equal, select the material which has the highest machinability rating.

Attempt in the design to keep the number and duration of machining operations at a minimum.

External surfaces, whenever possible should be machined with a single forming tool. Often one rough and one finish form tool can do the work of several single point tools.

If form tools cannot be used, so design that standard tools can be used. Special tools are justified only when they can promise great economies.

Design so that all of the machining operations which can be done on a screw machine are completed before the piece is cut off.

Design Don'ts

Do not specify dimensional limits which are closer than necessary to assure proper functioning of the part. It is possible to hold dimensions to 0.0005 in. or less, but only at a sacrifice of speed.

Unless there is an extremely good reason for doing so, avoid specifying threads that require the use of bottoming taps.

Don't specify the removal of burrs on the screw machine unless this is the only place it can be done. Tumbling or other methods of deburring is probably much less expensive.

Don't demand a finish that is finer than that normally left by the tool being used. If a better finish must be obtained, be sure to specify just where and how much smoother to avoid finishing the whole piece to that extent.

Machinability Ratings of Various Materials for Screw Machine Use

SCREW MACHINE STEELS	
SAE 1120 (leaded)	140
SAE X1112	140
SAE 1112	100
SAE X1314	90 to 95
SAE X1315	90 to 95
SAE 1120	70 to 75
SAE X1335	70 to 75
SAE X1350	70 to 75
CARBURIZING STEELS	
SAE X1020	50 to 65
SAE 1025	50 to 65
SAE 1020	50 to 65
SAE 1015	50 to 65
SAE 6120 (annealed)	45 to 50
SAE 6115	45 to 50
SAE 3115	45 to 50
SAE 4615 (annealed)	45 to 50
SAE 2315 (annealed)	45 to 50
SAE 3215	45 to 50
HEAT TREATING GRADE STEELS	
SAE 1035	55 to 60
SAE 1040	55 to 60
SAE 1045 (annealed)	55 to 60
SAE 4130 (annealed)	40 to 50
SAE 4140 (annealed)	40 to 50
SAE 3140 (annealed)	40 to 50
SAE 6135 (annealed)	40 to 50
SAE 6140 (annealed)	40 to 50
SAE 6150 (annealed)	40 to 50
SAE 1335 (annealed)	40 to 50
SAE 1350 (annealed)	30 to 40
SAE 2330 (annealed)	30 to 40
SAE 2345 (annealed)	30 to 40
SAE 3140	30 to 40
SAE 2345	30 to 40
SAE 52100 (annealed)	30 to 40
STAINLESS STEELS	
Iron, free cutting (14% Cr)	60
Steel, 18:8	30
Steel, free cutting 18:8 (annealed)	50
NONFERROUS METALS	
Magnesium Alloys	500 to 2000
Aluminum Alloy 11S	500 to 2000
Aluminum Alloy 2S	300 to 1500
Aluminum Alloy 17S	300 to 1500
Brass, leaded	150 to 600
Brass, yellow	200
Brass, red	200
Bronze, lead bearing	200 to 500
Gun Metal	60
Bronze, manganese	40
Nickel	20
Monel Metal	45
Bronze, silicon	60

Values are for operations, such as turning, forming, drilling, threading, and cutting off using high-speed steel tools and conventional cutting fluids. Ratings are based on a value of 100 for Bessemer screw stock, SAE 1112, using a cutting speed of 150 f.p.m. "Annealed" indicates bar was annealed before cold drawing. Otherwise bars are cold drawn from the hot-rolled condition. Values are only indicative and will vary somewhat with conditions and operations.

Materials

Outside of the speed, accuracy and finish attainable on screw machine products through normal procedures, the most important advantage of this method of producing parts is the fact that such a wide range of materials can be used. Most production methods which could be considered competitive to screw machining can handle only a limited number of materials.

All of the following materials can be and are being used for screw machine products: Low carbon iron and steels, high carbon steels, stainless steels, drill rod, bronzes, brasses, nickel-base alloys, noble metals, zinc, aluminum and its alloys, magnesium alloys and several types of plastics.

It should not be assumed that all materials are equally satisfactory for making parts by means of the screw machine. The important point is that if a certain material must be used, the chances are strong that the choice of material will not rule out production of the part via the screw machine.

Costs of screw machine products rise with any increase in difficulty of machining. First, the added difficulty lowers the output of the desired part, or if speed is upheld the finish is less satisfactory. Second, the machining itself cost more due to greater power requirements and greater wear and tear on the tools.

Free machining brass is probably the most widely used and most economical material from which to shape screw machine products. Although the brass selected may be quite high in cost, the total cost might be only slightly more than some of the other materials due to the high scrap recovery. Brass is often chosen when the finished part is to be electroplated later.

When steel is required, SAE X1112 is often considered best due to its high machinability rating. In addition to machining readily, SAE X1112 gives an excellent finish. Certain stainless steels have reasonably good machining qualities, but not, of course, as good as brass and free machining steels.

If the parts are of uncomplicated design, aluminum and magnesium alloys should be considered. These mate-

rials are the most readily machined of any metals now in use. Their machinability ratings range from four to ten times higher than the brasses and up to 14 times that of the more easily machined steels.

Special forms of materials can often be chosen at a great saving in material cost and with the added benefit of reducing the total machining requirements.

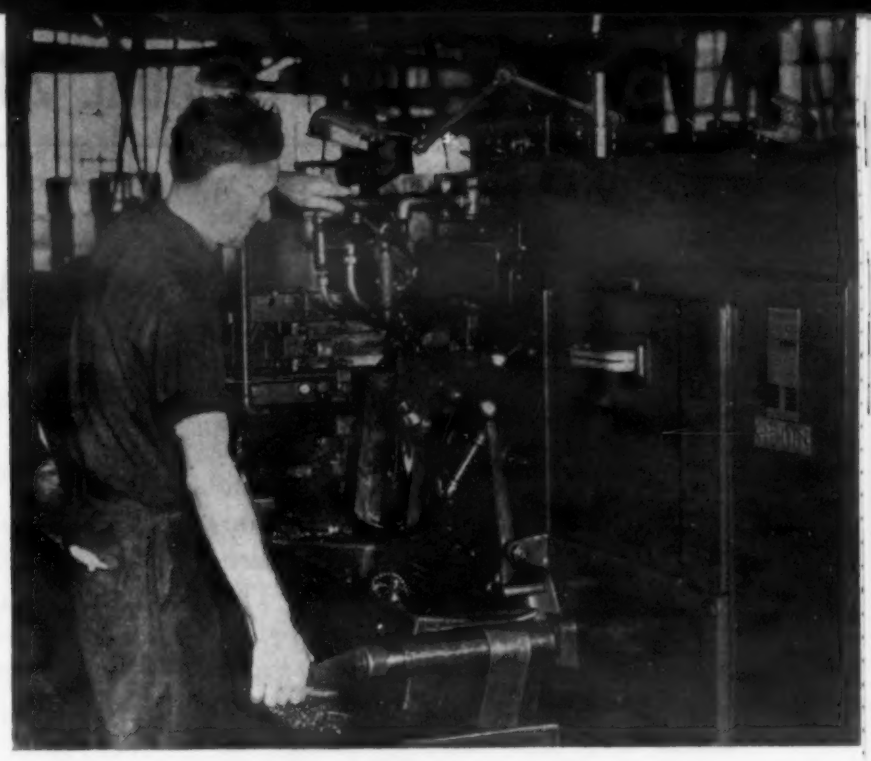
Where large hollow parts are required it might be well to investigate steel tubing. Most producers of tubing provide a wide range of wall thicknesses. In those cases where tubing can be used there is also a considerable saving in scrap.

Small nonferrous tubing is used advantageously as a raw material for screw machine products.

Special drawn and extruded shapes of metals, in all probability, will find increasing application for certain types of products. An example would be hex bars for the production of bolts, on parts that require a hex shape over part of their lengths and round shapes elsewhere.

Prior to the war plastics did not often appear in screw machine products, but during the last five or six years there has been a considerable quantity of plastic materials used in this way. There are now available many plastic rods—some of them in a variety of colors—offer a wide range of properties. While the physical properties of plastic screw machine products do not compare with similar properties of metals, there are many places where plastic parts serve admirably. It is interesting to note that the rapid increase in the use of plastics of all types has had the effect of adding another market for metal screw machine parts as inserts to be molded into or otherwise anchored in the plastic product.

Whereas the selection of a material is not too critical as far as actual production is concerned, the material choice can be the difference between a profitable use of this metal form and an economic waste of a valuable production method.



Tapered roller bearing cones are turned out at the rate of 90 per hr. on an automatic screw machine. (Courtesy: Timken Roller Bearing Co.)

Economics of Screw Machine Products

It is difficult to set forth any hard and fast rules as to the costs of screw machine products except to say that when a properly designed part is to be made of a reasonably free machining material and is needed in sufficient quantities no other metal form can compete on a cost basis.

Costs vary, of course, with the material or material form selected. Machinability, original cost, scrap recovery rates and the original cost of the material all have a strong effect upon total cost per piece.

Tooling costs for screw machine products are moderate. In fact where simple shapes are involved tooling costs can be said to be negligible. Even when the part is complicated, tooling costs can be only a fraction of that required for other methods of production. One of the most complicated tasks in setting up automatic screw machines is now being overcome by the use of quadrant linkage in multiple-spindle machines.

Generally speaking, finishing costs are low on screw machine products since most such products come from the machines with extremely fine finishes. Of course, some products are plated or otherwise finished. When this is done the costs vary little from similar finishing of other parts.

The biggest cost saving in screw machine products lies in the fact that direct labor requirements are low. One man can handle a whole battery of screw machines.

After tooling is ready there is the matter of set-up time. Here again wide variances are possible. On most jobs multiple-spindle machines can be set up in from 4 to 8 hr. Single spindle machines should not require more than 2½ hr. to set up. These times are longer than are required for some methods that are possible competitors, but they are also less than for other competitive methods.

The most important advantage as far as costs are concerned is the high speed of production of screw machine products. There is no other metal shape of comparative complexity that can be turned out as fast without a disproportionate investment in equipment. It is not uncommon to attain hourly rates of from 3,000 to 4,000 pieces.

While no flat statements can be made as to the costs of screw machine products, it is safe to assume that, when properly assigned, parts to be produced by automatic screw machines will be considerably less than if the same parts were to be made by another method.

Swiss Automatic Products

Up to this point the discussion has been centered about the products of the American type screw machine. During the war this country's manufacturers became familiar with a European machine and its products. This machine known as either a Swiss automatic or Swiss automatic screw machine has been the backbone of European watch and instrument making for about 50 years.

Swiss-type machines were manufactured in this country during the war years and will continue to be available from domestic machine tool builders.

Whereas the more common screw machine is suited to parts of fairly large diameter and comparatively short length, Swiss automatics are ideally adapted to producing long, slender pieces. Generally, Swiss machines are assigned to those products which are too small, too slender or too intricate for the turret-type machines.

American produced Swiss type machines are available with maximum chuck capacities of 5/32, ⅜, 7/16 and ½ in. Standard 5/32-in. machines can handle lengths to 1-9/16 in., while the largest capacity Swiss-type (½ in.) produces pieces up to 2¾ in. long. Parts have been produced as small as a pin 0.005-in. in dia. and 1-in. long.

Products which are ideally suited to Swiss-type machines include pinion blanks, studs, work gears, shafts of various sorts and other minute, slender parts such as are used in watches, clocks and industrial and military instruments.

With a proper combination of feeds and speeds, Swiss automatics can produce parts with surfaces ranging in roughness from 5 to 50 microinches. Instrument parts average 12 to 16 microinches.

High accuracy is also possible on parts produced by Swiss automatics. Runout on small pieces is usually less than 0.0005 in.

Many of the design limitations which restrict the shape of parts made on turret-type automatics are not important with the Swiss-type machines. Sharp corners, pivot points, back shoulders, multiple diameters, tapers and other complex shapes can be attained easily.

Swiss-type automatics are designed primarily for turning and employ single point tools or simple form tools. Special attachments can be provided for drilling, chamfering, counterboring, tapping, threading, knurling, reaming, burring and slotting.

Materials

The range of materials is not quite so great with Swiss-type machines as with other screw machines. Brass, bronze, aluminum, stainless steel and ordinary steels are most frequently employed. Much of the material is supplied in the form of drill rod with a carbon content averaging about 1.0%. The rod is usually centerless ground to a high degree of accuracy. Material costs for ground drill rod are extremely high, but when the accuracy obtainable is considered the cost is not excessive.

When stainless steel products are called for, the stainless steel is also furnished ground to about the same limits as drill rod (between 0.0003 and 0.0005 in. depending upon diameters). Carbide tools must be used in producing stainless steel parts to attain the sharp corners which are so often required in instrument parts. Too, carbide tools add to the life between grinds of the tools.

Naturally, the higher the machinability rating of the material being cut the faster is the production rate on Swiss type machines. Regardless of materials, Swiss-type machines are generally slower than turret-type automatics.

Conclusion

If the product you have in mind is anywhere in the area from 0.005-in. to 2½-in. in dia. and is 6-in. long or less it is well to consider producing it on one of the commonly used types of automatic screw machines.

Although 1,000 parts is generally cited as the minimum number of parts to be produced economically on automatic screw machines there are circumstances which make this figure vulnerable. If the part to be made would require a great number of different single purpose machines to generate the desired form a generous time saving might be made through the use of an automatic screw machine. Likewise, if quantities of less than 1,000 are required at relatively frequent intervals it might be economical to provide the screw machine cams and tooling and hold for reuse.

Since there are so many variables which govern whether or not a screw machine product is best for any purpose it is difficult to lay down any stringent rules other than those of size and the need for rotational surfaces to decide. Each individual part should be considered on its own. As far as strength characteristics are concerned, there is practically no limitation, since any machinable material can be used.

Occasionally it has been found advantageous to break down one product which could not be produced by automatic screw machines into 2 or 3 components which could be. The components can then be joined by welding or brazing and still cost less than the original design.

Although many of the advantages and restrictions of screw machine products have been set forth in this manual no final decision on a part should be made without consulting a screw machine engineer.

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- CONFORMABILITY
- NATION WIDE SERVICE

MOST manufacturers find themselves in a critical situation today. Material and labor costs are still advancing. Competition is becoming keener. Some ways must be found to keep finished product prices from going higher. Manufacturers realize that the one who can produce the most efficient unit at the lowest price will command the market.

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Engineering Shop Notes

Bending Heavy Aluminum Spar Caps

by P. F. Girard,
Ryan Aeronautical Co.

Ryan Aeronautical Co. has just completed the severe bending of some of the heaviest, if not the heaviest, spar caps made of 75ST aluminum alloy. This work was accomplished on an experimental basis for a jet-plus-propeller Navy fighter.

A study of the alloy, 75ST, shows that in spite of its disadvantages for bending at room temperature, it is easier to work at elevated temperatures than any other aluminum alloy. At temperatures of from 275 to 300 F, it has better forming qualities than either 24ST or 14ST have at 400 F. Also, there is no material change in the mechanical properties of the alloy in this temperature range. There is a slight tensile strength increase which is dependent upon the time that the metal is held at temperature. A slight decrease in elongation accompanies the stretching required at the bend area.

With these facts in mind, it was decided to heat the spar caps and bend them at a temperature of 300 F. To accomplish this, a special set-up was arranged. First, Kirksite metal rocker blocks were installed on the spar cap. They were contoured to the spar section and insulated from it by sheets of Micarta. These rocker blocks ride on greased, hardened steel plates so that they may slide outward under pressure of bending. Then, the spar cap was placed in a hydraulic press and a steel punch was attached to the upper head of the press. This tool was also contoured to the spar cap and insulated from it.

Close-up of spar cap at the location of the bend. Notches were cut in the compression legs.

For heating the spar cap prior to bending, an ignitron contactor panel, phase shift control and transformer were used. Primary plant current of 440 v., 60 cycle a.c. was fed to the ignitron, the igniters of which were controlled by a heat control. Here, the current was altered in conformity with the heat control's setting which automatically determines the percentage of current required. The transformer takes the 400-v. current and converts it to 15,000 amp. at 9 v.

The ignitron, transformer and conductors are water-cooled conductors to the section of the spar cap to be bent. The spar cap was slightly roughened with 50 grit paper where the conductor clamps made contact. Spacing of the clamps was carefully determined by estimating the amount of metal desired between the contacts in order to produce the proper heating effect.

When the switch was contacted, a flow of current flowed between the spar cap clamps and quickly heated the metal to 300 F. At this point, the hydraulic press was started and the punch lowered with a pressure running up to 75,000 lb. The correct amount of bending was indicated by gages attached to the spar cap extremities. After bending the spar caps for sweepback, they were removed from the press and turned to bend them for the necessary dihedral.

Due to the great amount of compression strain occurring during the forming operations, it was necessary to cut notches in the compression legs of some of the spar caps to prevent extreme distortion. These notches were generously rounded and polished and no danger of premature fatigue failure resulted from their use.

For best results when hand reaming aluminum, the drill diameter should be 0.99 times the reamer diameter. If the hole were to be machine reamed, the drill diameter could be 0.98 times the reamer diameter.

Special Lubricated Lathe Center

A special lubricated lathe center devised at a General Electric plant prevents shaft centers from "picking up" when machining heavy shafts. It permits the shaft to be lubricated while a cut is being taken, and makes it easy to keep the lubricant free from foreign matter.

Lubricant is introduced into the hole in the center of the shaft by a pressure gun through a fitting on the shank of the lathe center. When the shaft center is full, extrusion takes place along a 1/16- x 1/16-in. groove on the outside of the lathe center.

As the shaft turns, the lubricant is wiped against the shaft center. The groove is positioned where there is low pressure between the machine center and the shaft center. This gives the best possible adhesion of the lubricant to the shaft center.

An alloy 60 copper, 20 nickel and 20% manganese has been adopted by one of the leading watch manufacturers for gears and escapement wheels. In making these parts, diamond pointed milling cutters are used and it has been found that this alloy can be machined with no burrs. The manganese used in the 60-20-20 alloy is electrolytic. It is supplied by the Electro Manganese Corp. of Knoxville, Tenn.

MATERIALS & METHODS **Engineering File Facts**

NUMBER 146
August, 1947

MATERIALS: Magnetic and Electrical Materials

Magnetic and Electrical Materials

Magnetic and electrical materials include those materials used for permanent magnets, electromagnets and core materials (for transformers, motors and generators, etc.); representative types of each are listed in Table I.

It is to be noted that these materials require heat treatment to enhance their magnetic and/or electrical properties. In many cases the materials can only be ground after this final heat treatment operation has been performed.

Table 1—Important Properties of Magnetic and Electrical Materials

Alloy Name	Nominal Composition, %	Coercive Force, H_c Oersteds	Remanence, B_r Gauss	Energy Product $(H_d B_d)_{max}$ Minimum	Peak Magnetizing Force, H_{max} Oersteds	Peak Induction B_{max} Gauss	Density Lb/In³	Commercial Forms	Commercial Methods of Fabrication and Finishing	Remarks
Carbon Steel	C 1, Mn 0.5, Fe bal.	48	8,600	180,000	300	14,800	0.280	Wrought	Forge, machine, punch	Carbon steel is seldom used for permanent magnets since the development on the higher alloy steels and the dispersion-hardening (or precipitation hardening) materials which have superior magnetic properties
Tungsten Steel	C 0.7, W 6, Fe bal.	70	10,500	320,000	300	14,500	0.292	Wrought and cast	Forge, machine, punch, cast	
Chromium Steel	C 0.90 to 1.00, Cr 2 to 4, Mn 0.20 to 0.50, Si 0.30 max.	55	9,500	240,000	300	—	—	Wrought and cast	Forge, machine, punch, cast	
Chromium Steel	C 1, Cr 3.5, Fe bal.	63	9,000	290,000	300	13,500	0.280	Wrought and cast	Forge, machine, punch, cast	
Cobalt Steel	C 0.8, Co 17, W 8, Cr 2.5, Mn 0.3, Fe bal.	150	9,500	650,000	1,000	15,000	—	Wrought and cast	Forge, machine	
Cobalt Steel	C 0.7, Co 38, W 5, Cr 4, Mn 0.3, Fe bal.	240	10,000	980,000	1,100	15,600	0.296	Wrought	Forge, machine	
Cobalt Steel	C 0.7, Co 36, W 5, Cr 4, Mn 0.3, Fe bal.	240	8,500	940,000	1,000	14,800	0.296	Cast	Cast, forge, machine	
Alnico 1	Al 12, Ni 20, Co 5, Fe bal.	400	7,100	1,300,000	2,000	12,350	0.249	Sand or precision cast	Cast and grind	Generally used in sections 1 in. x 1 in. or larger[1]
Alnico 2	Al 10, Ni 17, Co 12.5, Cu 6, Fe bal.	540	7,200	1,600,000	2,000	12,600	0.256	Sand or precision cast	Cast and grind	More economical for magnets weighing over 15 GR (½ oz.)[1]
		520	6,900	1,430,000	2,000	12,000	0.249	Sintered	Sinter and grind	Sintered Alnico is as hard but less brittle than cast Alnico[2]
Alnico 3	Al 12, Ni 25, Fe bal.	450	6,700	1,380,000	2,000	12,000	0.249	Sand or precision cast	Cast and grind	Generally used in sections over ⅜ in. x ⅜ in.[1, 8]
Alnico 4	Al 12, Ni 28, Co 5, Fe bal.	700	5,200	1,200,000	3,000	11,850	0.253	Sand or precision cast, or sintered	Cast or sinter and grind	Used in magnetic chucks, clutches and separators[1, 9]
Alnico 5 (Ticonal)	Al 8, Ni 14, Co 24, Cu 3, Fe bal.	575	12,000	4,500,000	2,000	15,700	0.264	Sand or precision cast	Cast and grind	Has highest energy-product and B_r of all commercially available materials[1, 4]
Alnico 6	Al 8, Ni 15, Co 24, Cu 3, Ti 1.25, Fe bal.	750	10,000	3,500,000	3,000	14,300	0.268	Sand or precision cast	Cast and grind	[1, 4]
Alnico 12	Al 6, Ni 18, Co 35, Ti 8, Fe bal.	950	5,800	1,500,000	3,000	12,800	0.264	Sand cast	Cast and grind[2]	Has the highest H_c of all types of Alnico[1]
Comol or Remalloy	Mo 17, Co 12, Fe bal.	250	10,500	1,100,000	1,000	17,000	0.295	Wrought and cast	Forge, cast, machine, punch	—
Vicalloy I	Co 52, Fe 38.5, V 9.5	300	9,000	1,000,000	—	—	0.296	Cast and wrought	Cast, machine, punch, forge (lightly)	These alloys combine good machinability and mechanical properties with superior magnetic qualities[6]
Vicalloy II	Co 52, Fe 35, V 13	520	10,000	2,000,000 to 3,500,000	—	—	0.293	Wrought	Severely cold worked	
Cunife I[13]	Cu 60, Ni 20, Fe 20	600	5,800	1,960,000	2,400	8,400	0.311	Wire	Machinable	Cunife is ductile and machinable even after hardening[4]
Cunife II	Cu 50, Ni 20, Fe 27.5, Co 2.5	260	7,300	780,000	2,400	9,500	0.311	Wire and strip	Machinable	
Cunico	Cu 50, Ni 21, Co 29	660	3,400	800,000	3,200	8,000	0.300	Wrought and cast[14]	Cast, machine, cold roll, punch	Easily machined prior to final heat-treatment
Vectolite	$Fe_2O_3.30$, $Fe_2O_3.44$, $Co_2O_3.26$	1,000	1,600	600,000	3,000	4,800	0.113	Sintered	Sinter and grind[11]	Has light weight, high H_c and very high resistivity[4]
Silmanal	Ag 86.75, Mn 8.8, Al 4.45	6,000	550	75,600	20,000	20,830	0.325	Wrought rod, sheet and strip	Readily machinable	Max. length of magnets 1½ in.
Supermalloy	Ni 79, Fe 15, Mo 5, Mn 0.5	0.002 to 0.005	—	—	2	7,900	—	Wrought strip	Roll, punch	Permeability is very high (600,000 to 1,200,000) at low inductions[7]
Nipermag	Al 12, Ni 32, Ti 0.4	675	5,500	1,340,000	—	—	—	—	—	—
Mu Metal	Ni 76, Cu 4, Cr 1.5, Fe bal.	0.015	2,300	$\mu_{max} = 100{,}000$	0.22	5,000	0.311	Hot rolled sheets and cold rolled strip	Roll, punch, draw, machine	Resistivity = 60 Microhm-CM.
Hipernik	Ni 50, Fe 50	0.03	8,000	$\mu_{max} = 100{,}000$	—	—	0.300	Sheet	Roll	Resistivity = 45 Microhm-CM.
Electrical Alloy Steel	Ni 48, Fe 52[9]	0.07	6,000	$\mu_{max} = 150{,}000$	0.9	10,000	0.296	Sheet and strip	Roll, punch, draw, machine	Has higher saturation than Mu-Metal

(Continued on page 117)

AN IMPORTANT ANNOUNCEMENT

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PROPERTY	LUSTREX
Molding quality	Excellent
Injection Mold. Temp. °F.	350-550
Injection Mold, Pressure, psi	10,000 and up
Specific Gravity	1.05
Flexural Strength, psi	12,000-14,000
Flexural Deflection, inches	0.15-0.25
Impact Strength, ft. lbs. per inch, (unnotched)	3.2-3.6
Heat Distortion Temp., °C. (air bath)	87-88
Dielectric Constant, 1 megacycle	2.5-2.7
Power Factor, 1 megacycle	0.0001-0.0005
Water Absorption, % (24 hrs.)	0.04-0.05

MONSANTO
CHEMICALS AND PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

NUMBER 146 (Continued)

MAGNETIC AND ELECTRICAL MATERIALS

Alloy Name	Nominal Composition, %	Coercive Force, H_c Oersteds	Remanence, B_r Gauss	Energy Product $(H_c B_d)_{max}$ Minimum	Peak Magnetizing Force, H_{max} Oersteds	Peak Induction B_{max} Gauss	Density Lb/In³	Commercial Forms	Commercial Methods of Fabrication and Finishing	Remarks
Permalloy	Ni 78.5, Fe bal.	0.06	—	μ_{max} = 100,000	—	—	—	Sheet and strip	Roll, punch, machine	High permeability, low loss material
Mo-Permalloy	Ni 78.5, Mo 3.8, Fe bal.	0.05	—	μ_{max} = 75,000	—	—	—	Sheet and strip	Roll, punch, machine	High permeability, low loss material
Perminvar	Ni 45, Co 25, Fe bal.	1.2	—	μ_{max} = 2,000	—	—	—	Sheet and strip	Roll, punch, machine	Has constant permeability
Mo-Perminvar	Ni 45, Co 25, Mo 7.5, Fe bal.	0.62	—	μ_{max} = 3,800	—	—	—	Sheet and strip	Roll, punch, machine	Has constant permeability
Electrical Sheet Steels	Si 0.5 Si 1.0 Si 2.5 Si 3.25 to 4.0 Si 4 to 5	Core Loss: 1.30 to 1.98 w/lb[10] 1.17 to 170 1.01 to 1.30 0.82 to 1.10 0.52 to 0.85		μ_{max} = 2,500 to 8,000	Resistivity: 19[11] 25 45 56 60 to 65	— — — — 20,000[12]	— — — — 0.274	Usually rolled in #29, 26, 24 USS gage thicknesses (size of sheets is generally 30 x 108 in.)	Punch, machine	Used for laminations for motor and generator fields, transform cores, chokes, reactors, solenoids, etc.
Ingot Iron	Fe 99.8+	H_c = 1.0 B_r = 13,000		μ_{max} = 7,000	Resistivity: 11[11]	22,000[12]	0.285	Wrought	Machine, roll	For comparison purposes

[1] *See Table 2 for important physical properties of cast Alnico.*

[2] *See Table 3 for important physical properties of sintered Alnico.*

[3] *Lowest cost Alnico available.*

[4] *Has directional properties; magnetic values given are those produced by magnetization along the direction of the applied during heat treatment.*

[5] *As a result of the final heat treatment this material becomes very brittle and is usually ground before this final heat treatment operation.*

[6] *Data taken from "Vicalloy—A Workable Alloy for Permanent Magnets," E. A. Nesbitt, Tech. Publ. No. 1973, AIME, Feb., 1946.*

[7] *"A New Magnetic Material of High Permeability," Boothby & Bozorth, J. App. Phys. Vol. 18, Feb., 1947, pp. 173-176.*

[8] *Vectolite is generally sintered to final size as it is very weak mechanically and can only be ground if the grinding is carefully controlled.*

[9] *This material is used for cores where good permeability at low flux densities and low resistivity are required; by adding either molybdenum or silicon to this analysis, materials having better high frequency characteristics are obtained. A comparison of the resistivities and saturation values of these three materials is tabulated below:*

Material	Resistivity (Microhm-Cm)	Saturation (Gausses)
Ni + Fe Alloy	*52*	*16,000*
Ni + Fe + Mo	*80*	*15,000*
Ni + Fe + Si	*90*	*11,000*

[10] *Watts/lb. at 60 cycles with B = 10,000 gausses.*

[11] *In microhm-cm.*

[12] *Saturation value.*

[13] *The best magnetic properties are obtained in sound sections of less than 0.155 in. dia.*

[14] *Cunico magnets can be made from rod, strip and wire, or may be sand or precision cast. Magnets ¼- to 1-in. dia. are usually machined from rod; sizes larger than 1-in. dia. can be cast, but will have lower magnetic properties.*

[15] *Magnets may be punched and formed from strip 0.005- to 5/16-in. thick and up to 2 in. wide.*

Table 2—Physical Properties of Cast Alnico Magnets

Property	Alnico 1	Alnico 2	Alnico 3	Alnico 4	Alnico 5	Alnico 6	Alnico 12
Resistivity, Microhm-CM. at 25 C	75	65	60	75	47	50	62
Tensile Strength, Psi.	4,100	3,000	12,000	9,100	5,450	23,000	39,500
Transverse Modulus of Rupture, Psi.	13,900	7,200	22,500	24,000	10,500	45,000	50,000
Mean Coef. of Expansion per Deg. C (x10⁻⁶)	12.6	12.4	13.0	13.1	11.3	11.4	11.0
Hardness, Rockwell C	45	45	45	45	50	56	58
Approximate Standard Tolerances for Sand Cast Alnico Magnets, In.—							
0 to 2 in.	±0.015						
2 to 4 in.	±0.032						
4 to 6 in.	±0.045						

Table 3—Physical Properties of Sintered Alnico Magnets

Property	Alnico 2	Alnico 4
Resistivity Microhm-CM. at 25 C	68	68
Tensile Strength, Psi.	65,000	60,000
Transverse Modulus of Rupture, Psi.	70,000	85,000
Mean Coef. of Expansion per Deg. C (x10⁻⁶)	12.4	13.1
Hardness, Rockwell C	43	42
Approximate Standard Tolerances for Sintered Alnico Magnets, In.—		
0 to 0.125 in.	±0.005	
0.125 to 0.625 in.	±0.010	
0.625 to 1.250 in.	±0.015	
1.250 to 3.000 in.	±0.031	
Maximum Cross-Sectional Area of Sintered Alnico Magnets, In.	2	

The following organizations very kindly furnished data used in the above tables:

Allegheny-Ludlum Steel Corp.
The Arnold Engineering Co.
General Electric Co.
The Indiana Steel Products Co.

Additional references:

"Metals and Alloys Data Book," Hoyt, Reinhold Publishing Corp., N. Y. (1943).

"Permanent Magnets," Goss, Metals and Alloys, Vol. 15, Apr. 1942, pp. 576-582.

"Permanent Magnet Steels," Ruder, Iron Age, Vol. 157, May 9, 1946, pp. 65-69.

Compiled by Robert S. Burpo, Jr.

MATERIALS & METHODS

DIGEST

A selective condensation of articles — presenting new developments and ideas in materials and their processing — from foreign journals and domestic publications of specialized circulation.

Edited by H. R. CLAUSER

Colloidal Graphite in the Metal Industry

Condensed from "Metallurgia"

Dispersions of colloidal graphite in a liquid form homogeneous films which adhere well to metallic surfaces. It is probably this property that has accounted for the wide use of colloidal, instead of flaked graphite for coating molds and cores in die casting, for parting in general, and for high temperature lubrication.

The painting of dies and cores in pressure and gravity die casting with colloidal graphite in water gives a highly efficient parting. Light alloys are now generally cast with such a film as the sole parting medium. After the formation of the initial coating, the graphite film is maintained by occasional applications of colloidal graphite in either water or oil.

The life of mandrels is increased by a graphite coating which likewise minimizes scoring. Colloidal graphite in oil has proved equally useful in the stamping of light alloys and in certain deep drawing operations.

Most fine tungsten and molybdenum wire is drawn with a concentrated dispersion of colloidal graphite in water. This form of lubrication reduces die wear and permits higher drawing speeds. Other nonferrous wires can be drawn with colloidal graphite, sometimes in combination with beeswax or soap. An active interest is being taken in the use of graphite as a lubricant for coarser gage wires, brass rods and tubes.

Colloidal graphite is used as a high temperature lubricant for the chains and moving parts of kiln cars and annealing ovens, the links of burden chains and hot rubbing faces of presses, and the working parts of die casting machines and automatic glassware equipment.

There is a growing technique of forming dry adherent graphite films on metallic and nonmetallic surfaces with volatile dispersions of colloidal graphite. The liquid carrier evaporates, leaving a film which can be used for lubrication, parting or other purposes. (*Metallurgia* (British), Vol. 35, Apr. 1947, pp. 301-302.)

Developments in Seamless Pipe Manufacture

Condensed from a Paper of the American Iron & Steel Institute

The National Tube Co. is in the process of building a mill at Lorain, Ohio, for the manufacture of seamless pipe and tubing in sizes below 4½ in. O.D., at production rates unattainable on existing conventional seamless mills, and with design features which will permit the rolling of seamless tubes of lighter walls and with dimensional tolerances not possible on the conventional or automatic seamless mills.

The process which is being utilized in the seamless mill now under construction employs units entirely different in characteristics from those of the conventional process. The first of these units is the continuous tube rolling mill which consists of nine tandem, individually powered stands of two-high grooved rolls. Essentially, the continuous tube rolling mill is similar to the modern strip mill in that the product passes progressively from stand to stand. The chief difference is that the tube mill requires an internal mandrel against which the work piece is rolled to reduce wall thickness. This cylindrical mandrel extends entirely through the pierced billet and passes through the mill with the work piece.

This mill will deliver pipe in 65-ft. lengths at rates up to 900 ft. per min. The overall wall reduction which will be made in the continuous rolling mill is approximately twice that now made in the conventional two-high mill. As a result of this increased wall reduction the productive capacity of the piercing mill has been stepped up.

After withdrawal of the mandrel, the rolled tubes are reheated before they are processed in the tension reducing mill. Tension reducing, which has recently been developed by the company, is unique in that without the use of a supporting mandrel the wall thickness is diminished while the diameter is reduced. This operation differs from the conventional reducing mill in which the wall thickness of the tube is increased as the diameter is reduced.

In the tension reducing mill the tension forces to which the tube is subjected between roll stands are not only effective in reducing the wall thickness of the tube but, in addition, make possible diameter reductions in successive stands more than 20% greater than can be made in the conventional mill. The faculty of permitting the entering tube wall to be maintained or reduced while large diameter reductions are being made in successive stands permits a single entering tube size to be employed for the production of all tube sizes in the size range 3½-in. O.D. to 0.675-in. O.D.

The maximum delivery speed of the unit will be about 2200 ft. per min., and the lengths of the smaller sizes will approach 400 ft. To maintain a high yield in the finished product of this mill, it is necessary to produce pipe in these relatively long lengths. This is brought about by the fact that the full effect of the tension forces is not brought to bear on the end sections of the tube and as a consequence the gage of these end sections exceed specified limits.

A rotary shear synchronized with the delivery speed of the tension reducing mill will sever the pipe into manageable lengths as it is delivered to the cooling table. (E. N. Sanders. Paper, *Am. Iron & Steel Inst.*, May 21-22, 1947 meeting, 9 pp.)

Hot-Shortness of Some Aluminum-Iron-Silicon Alloys of High Purity

Condensed from "Journal of the Institute of Metals"

Since much aluminum welding is done on commercial grades of aluminum, in which the chief impurities are iron and silicon, the effect of iron and silicon on hot-shortness is likely to be of great industrial importance.

A restrained weld test was used on alloys containing up to 0.6 silicon and 0.5% iron. A more extensive series of casting tests was made on alloys containing up to 4 silicon and 1% iron. There is a large measure of correspondence between the results of the two types of tests. In both cases,

NOW M & T OFFERS NI-ROD* for WELDING CAST IRON

Whether you want an electrode to repair worn or broken castings... to correct casting mishaps in the foundry...or even to make design changes—you'll find Ni-Rod the most satisfactory electrode in every respect for all types of welding work on cast iron.

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DIGEST

the cracks are intercrystalline and are formed at a high temperature.

Whereas super-pure aluminum does not crack appreciably, the addition of 0.1% silicon produces a noticeable degree of hot-shortness. As the percentage of silicon increases, the amount of cracking increases sharply to a maximum and then decreases to a low value. Additions of iron alone up to 0.5% have no appreciable effect on hot shortness. Alloys containing less silicon than iron are subject to only slight cracking.

Where iron and silicon are present together in quantities up to 0.4% each, only the excess of silicon over iron is effective in promoting hot-shortness. The excess of silicon needed to bring about maximum hot-shortness is approximately 0.5%. The effect of the iron is to delay the onset of cracking, to reduce the severity of cracking at the maximum, and to push the position of the maximum to a higher percentage of silicon.

The theoretical explanation of the inhibiting effect of iron on the cracking of castings and welds is not at all clear. The important conclusion is that the silicon content should not exceed the iron content when commercially pure aluminum is to be cast or welded in conditions where contraction stresses may arise. (A. R. E. Singer & P. H. Jennings. *J. Inst. Metals* (British), Vol. 73, Part 5, 1946/7, pp. 273-284.)

Steel Forging Practice in Germany

Condensed from "Iron and Steel"

The German forging practice was not very different from the British. Round ingots were fairly common and a number of the heavier type were cast narrow end up with a very small taper. In most cases, the taper of the head was more pronounced than is usual in Britain.

The larger furnaces were generally of the car or bogie type. In the majority of cases the job was handled from the bogie furnace by chains and manipulated at the press by burden chains operating through electric turning gear on the crane. In a number of works, mechanical manipulators had been installed but most of these had been discarded.

Krupps obviously believed that upsetting was beneficial for they upset a large number of types of forgings. Doxford-type crankshafts were produced in various factories. The closing-in of the ends of hollow forgings was carried out on specially designed presses.

A unique process was developed for strengthening large hollow vessels by wrapping strip steel in layers over the external surface. The general principle was similar to that employed for large guns but the strip was heavier and so designed in section as to interlock. This method had been advanced to such an extent that flanges and collars, instead of being forged, were built up by wrapping one layer on another. It was felt that such vessels were capable of withstanding the greatest pressures likely to be encountered and with a wall thickness less than that required if forged in one piece.

In all plants very close attention was paid to the treatment of large forgings after completion of the forging. The practice was to charge without delay into an annealing furnace for an isothermal-type anneal or into very well designed cooling pits. Gas fired pits were sometimes used so the cooling could be controlled. Cooling pits were extensively used in all the works visited. (J. Mowat. *Iron & Steel* (British), Vol. 20, Apr. 1947, pp. 157-160.)

French and German Aluminum-Silicon Alloys

Condensed from "Revue de l'Aluminium"

The Skoda plant in Czechoslovakia had the opportunity over the past few years to compare the French (Alpax) and German (Silumin) aluminum alloys with about 13% silicon. The following values are averages based on 272 heats:

Compensator for Iron	Source	Average % Magnesium	Cast Specimens: Separate: Yield Point Psi.	Separate: Ten. Str., Psi.	Separate: Elong., %*	Ingot: Yield Point Psi.	Ingot: Ten. Str., Psi.	Ingot: Elong., %*
Cobalt	France	0.203	31,720	38,830	7.45	28,870	36,130	7.15
	Germany	0.219	27,450	35,560	5.43	25,180	32,710	3.03
Manganese	France	0.227	33,000	38,970	4.19	30,860	36,130	2.94
	Germany	0.238	29,160	38,260	3.43	26,740	35,270	2.31

**gage length=five times the diameter*

It was concluded that it is preferable to use cobalt instead of manganese to overcome the deleterious effect of the iron present as an impurity.

Furthermore, the electrolytic means of fabrication used in France is superior as regards purity and fineness of structure to the thermal method used in Germany. In France, the alloy is made electrolytically by the addition of quartz, silicon or an aluminum-silicon alloy to the normal electrolyte. In Germany, the alloy is produced by the more economical thermal method where the aluminum is alloyed with a high silicon alloy produced by the thermal reduction, with carbon, of a mixture of kaolin and quartz. (M. V. *Rev. l'Aluminium* (French), Vol. 24, Feb. 1947, p. 68.)

Ceramics as Engineering Materials

Condensed from "Engineering Materials"

Ceramic technology is constantly evolving new materials and forming methods. The properties of ceramics can now be varied over a wide range and much attention is paid to forming with automatic machinery where possible. Temporary organic binders make it unnecessary to rely solely on the plasticity and dry strength of clay for forming. Drying time has been reduced by controlled humidity driers or infra-red heating.

Ceramic products have superior chemical resistance. Stoneware has long been regarded ideal for storing acids and alkalies. Porcelain and glass are unsurpassed for chemical ware. For the most exacting requirements, fused quartz can be used for almost all acids and pure sintered alumina for all alkalies.

The highest mechanical strength can be expected from sintered oxides such as alumina. Steatite and zircon also show exceptional strength and can be formed more economically. Resistance to heat is one of the outstanding properties of ceramics. Highly refractory materials are made from aluminum silicates or pure refractory oxides. Resistance to thermal change is governed mainly by the thermal expansion and can be controlled within wide limits. Two outstanding low expansion ceramics are fused quartz and Cordierite (magnesium aluminum silicate). The porosity can be varied from high values, as for filtering or heat insulation, to low values for pressure or vacuum tight ceramics.

Most ceramics are insulators of electricity but some special materials conduct electricity so they can be used for electrical resistors. Vitrified ceramics, especially high mullite, alumina, steatite, and zircon porcelains, are unsurpassed for high voltage insulation. For high frequency applications, where the dielectric loss is important, steatite and fused and sintered quartz are outstanding. Where materials are used as dielectrics in capacitors, the dielectric constant must be considered. Only ceramic materials can have dielectric constants varying from five to 1200 and over. (Felix Singer & Hans Thurnauer. *Engineering Materials,* (British) Dec. 1946.)

Boron in Medium Carbon Steel

Condensed from "Metal Treatment"

The effect of boron contents up to 0.098% on 25-lb. heats of 0.45% carbon, 0.75% manganese steel was investigated. The results should be of interest because of the considerable work done on small boron additions to steel in this country.

Steels with up to 0.01% boron can be hot worked but above this limit red shortness occurs. Boron appears to have no effect on the strength of normalized steel but the reduction of area is decreased. The

DIGEST

nd impact falls seriously with over 0.007% oron. Tensile tests on oil quenched 1-in. ounds indicate that when the boron content high, its effect is most prominent with mpering temperatures under 390 F. There again a very sharp drop in the Izod mpact of the higher boron steels.

Boron contents up to 0.0065% have no dverse effect on the fatigue strength of ormalized steel. With 0.038% boron, owever, the endurance limit is reduced by 2%. Creep tests at 930 F in a Barr-ardgett apparatus were made on annealed pecimens. The limiting creep strength is rogressively and markedly lowered with ncreasing boron content.

Carburizing tests show that the amount of arbon absorbed increases with increasing oron content, but the depth of penetration emains practically constant. With 0.01% oron and higher, the hyper-eutectoid case changed to eutectoid pearlite with par-icles of a boron compound.

The hardenability is increased progres-ively with boron up to 0.01% but the ncrease at the usual levels of 0.003 and 0.007% is not as great as has been re-orted.

Steel with 0.0028% boron is more re-istant to 5% hydrochloric and 5% sul-uric acids than carbon steel. Likewise, teel with 0.007% boron is more resistant o atmospheric corrosion than boron-free teel. Higher boron contents produce no urther improvement. There is little dif-erence in the corrosion resistance to 3% agnesium chloride solution between the oron and the boron-free steels. (G. P. ontractor & J. S. Vatchagandhy. *Metal reatment* (British), Vol. 14, Spring 1947, p. 3-19.)

Progress in Powder Metallurgy

Condensed from Papers of the Metal Powder Association

Powder metallurgy continues to be a growing field. Its range of applications is expanding as more knowledge is obtained and as new metal powders are introduced. Improvements in the properties and char-acteristics are continually being made while new processes and procedures for producing metal powders are being developed. At the Spring Meeting of the Metal Powder Association a number of important papers were presented that highlighted this prog-ress.

Electronic Components from Powdered Metals

The use of electrical contacts made from metal powders is expected to increase. Al-though some of the basic uses are tied in closely with other industries, there are many other fields in which sintered contact mate-rials are expanding and in which they hold

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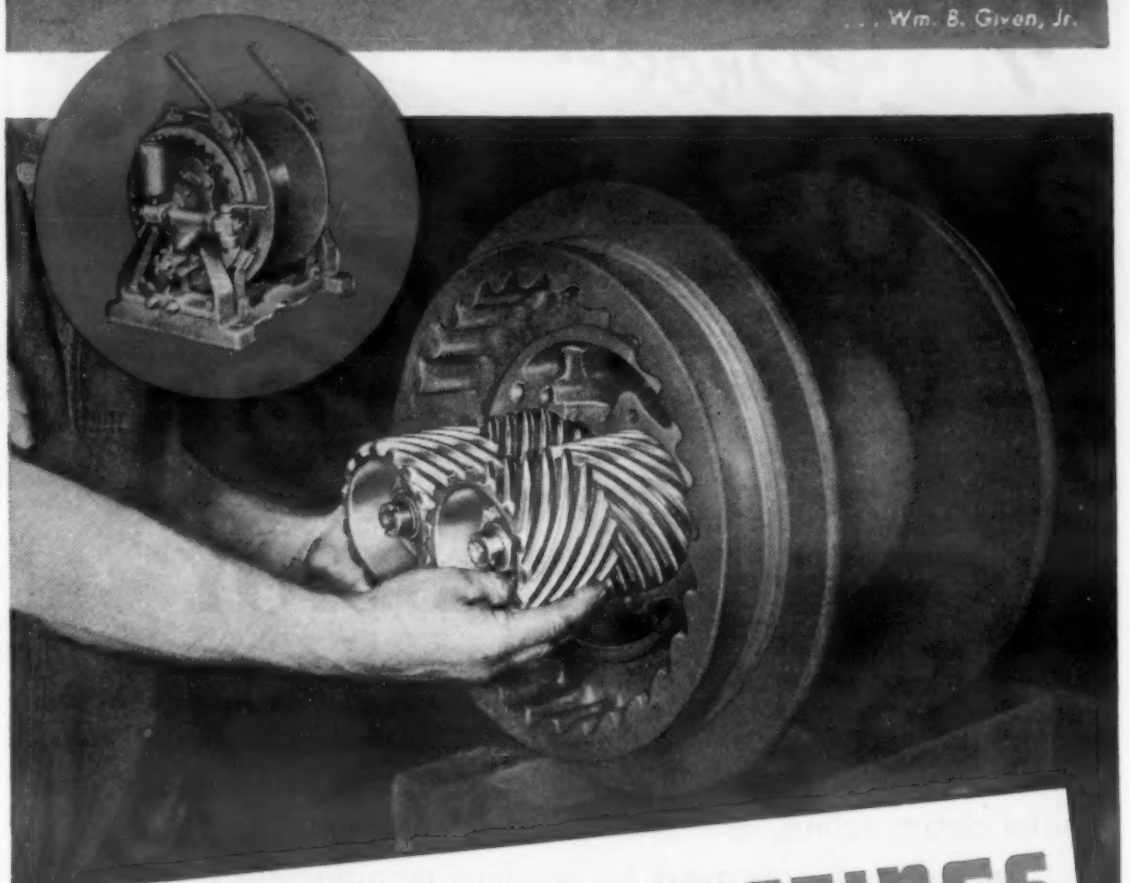

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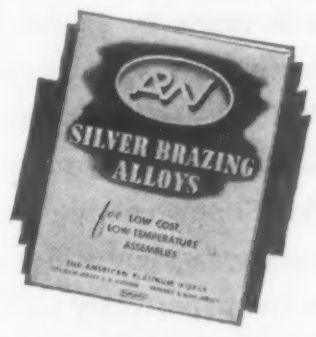

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PRECIOUS METALS SINCE 1875

DIGEST

the key to their own development. For example, small circuit breakers for domestic use were made possible because of the sintered contact materials—silver molybdenum and silver tungsten. The general direction of development lies in improving the important properties, such as contact, arc, and wear resistance, of the contact materials.

The metal graphite brushes used on commutators and slip rings are important items in the field of powder metallurgy. The most important materials used are copper and graphite. These materials are combined in all proportions and with additions of other metallic, inorganic, and organic materials. In the future development work for these applications, radical processing procedures and materials should be investigated.

A comparatively recent development is the use of sintered metal compositions for permanent magnets. It is expected that their use will increase.

The use of the soft magnetic materials made from powders have resulted in cheaper methods of fabricating and applying some of the complicated shapes. The applications in which sintered materials have competed successfully include pole faces for meters, field pieces for small motors and generators, and magnetic circuits for small specialized relays. Future work should develop iron powders that are purer and cheaper without sacrificing any of the good molding properties of a good electrolytic iron.

The field of powdered iron cores for high frequency applications is one of the largest in which metal powders are now being used. The powders used for iron cores are made by several methods. The most important are reduced iron, iron decomposed from iron carbonyl, electrolytic iron and mechanically pulverized iron. Certain alloy powders are also used for special applications. (Erle I. Shobert II. Electrical & Electronic Components from Powdered Metals, 19 pp.)

Steel Back Copper-Lead Bearings

Steel back copper-lead bearings have proven their value under heavy service conditions. But by methods requiring the melting and pouring of the alloy they have been expensive and hard to make, and became harder to make as the lead content was increased.

By the metal powder method the making of these steel back copper-lead bearings is much less troublesome. With the temperatures employed gasing is not a problem and because of the nature of the process, lead segregation is not encountered. The use of other elements than the copper and lead is unnecessary, allowing full advantage of the bearing qualities of the binary alloy to be realized.

In operation the process is continuous. Steel strip of the desired width and thickness passes from the coil through straightening

DIGEST

rolls past a powder spreader, through a controlled atmosphere electric sintering furnace with cooling chamber.

As may be expected, the character of the copper-lead powder is of major importance. It is an alloy powder in each particle of which the percentages of copper and lead closely approximate those desired in the finished bearing. The particles are spherical in shape and show when sectioned a sound structure and even distribution of lead. Flow and density characteristics are high, permitting even spreading with a minimum shrinkage in subsequent sintering and rolling.

The high purity of the powder is one of its important characteristics. Impurities have marked influence upon the character of bond between the copper lead and the steel back, upon the soundness of the sintered alloy, upon its mechanical properties and upon its bearing qualities. However, small amounts of silver or nickel and very small amounts of phosphorus may be added without harmful effect.

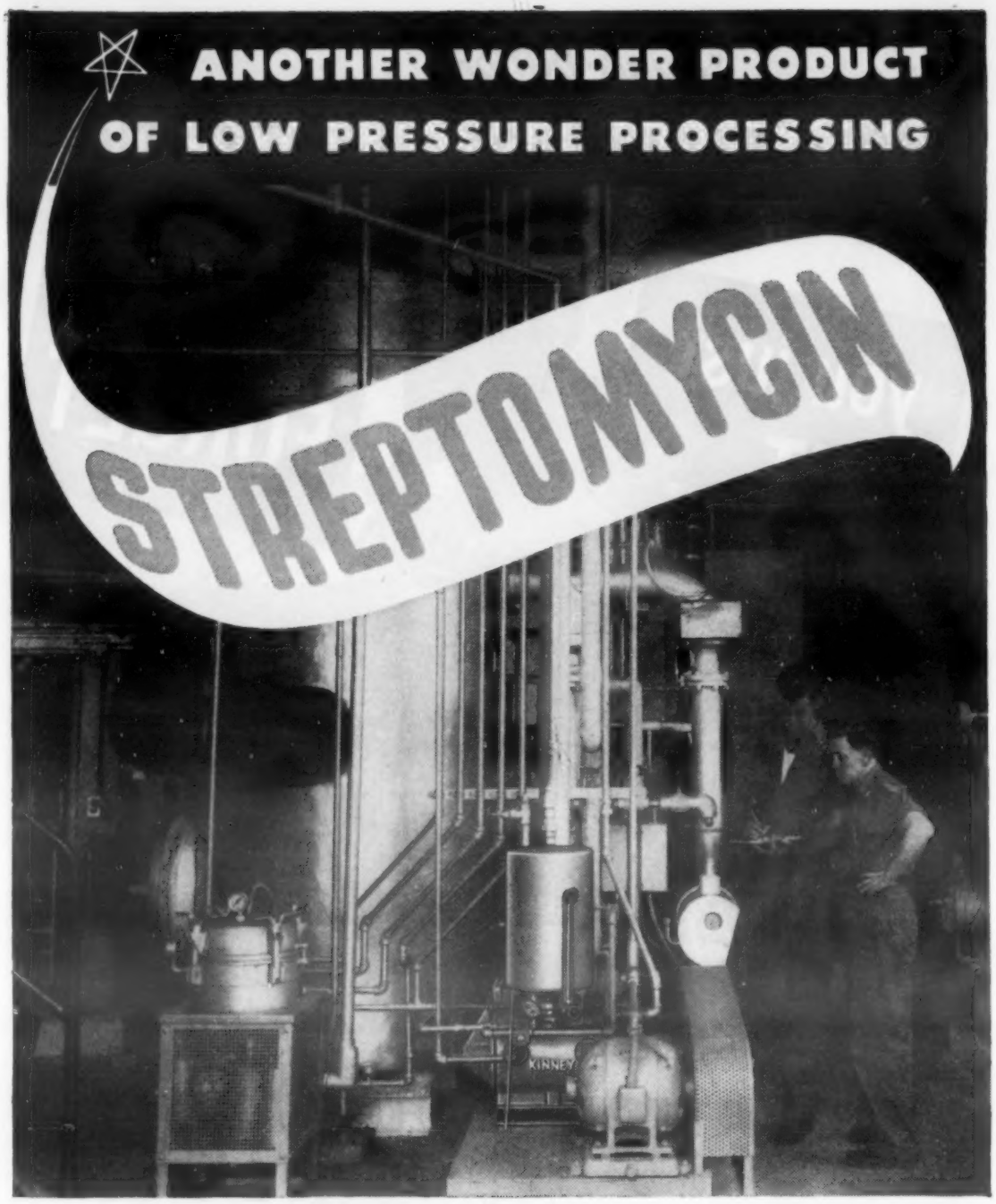
The mechanical properties of the copper-lead lining made by this process are higher than those of linings applied by centrifugal or gravity casting methods. For example, the average elongation of cast linings is 3%. That of the sintered variety is 8%. This increase in elongation is of particular value in forming operations, and bearing blanks may be cold flanged in presses without any cracking of the copper-lead layer and without rupturing its bond to the steel back. (E. R. Darby. Copper-Lead Bearings from Metal Powder, 3 pp.)

Production of Metal Parts

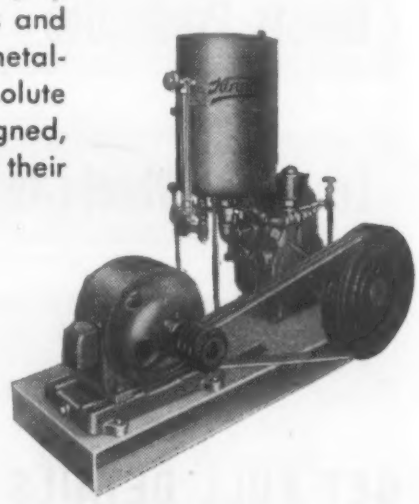
A recent development in the production of metal powder parts made at Ford Motor Co. represents a new concept of re-striking metal powder parts. It may be considered in many cases to be essentially an extrusion process. It was developed for making oil pump gears and, except for the re-strike operation, is no different from conventional methods.

To overcome eccentricity that developed in the parts during the re-striking, several methods were tried. The method which was successful involved holding the bottom punch in the ejection position with springs which allowed the core rod to pilot into it and remain all during the re-strike operation. In order to reduce the excessive die wear the re-striking was changed from a coining operation to one of extruding and the die was provided with an extrusion plate of high chromium, high carbon steel. Thus, in this process the gear was forced through the plate where it expanded in the solid die and then was extruded from the die through the plate.

Another difficulty of the holes in the gear tapering was encountered. This was overcome by using a secondary core rod which was inserted in the gear hole from the



Kinney High Vacuum Pumps play an important part in the freeze-dry process at the new Streptomycin Plant of Merck & Co., Inc. at Rahway, N. J. Under super sterile conditions, vapor from the sublimation dryer is frozen in a high vacuum at —80 deg. C. in the condenser and removed as snow. Kinney Vacuum Pumps are giving highly dependable service in the production of this and many other pharmaceutical, food, optical, metallurgical and other products where low absolute pressures must be maintained. Compactly designed, Kinney Vacuum Pumps save floor space, and their fast pump down and low ultimate pressures shorten production time and reduce costs. Kinney Single Stage Vacuum Pumps produce low absolute pressures to 10 microns; Compound Pumps to 0.5 micron.



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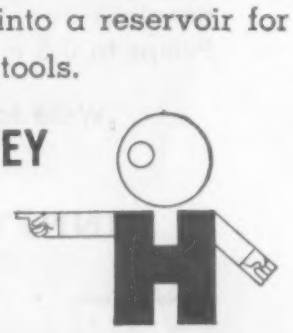

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bottom as the top core rod was withdrawn. This arrangement allowed them to extrude through the sizing plate and over the lower core rod, making the entire re-strike operation one of extrusion. (E. E. Ensign. New Developments in the Production of Metal Powder Parts, 17 pp.)

Stainless Steel Powder

A typical chemical analysis of the standard commercial stainless steel powder is: 0.11 carbon, 8.98 nickel, 17.36 chromium, 0.47 silicon, 0.022 phosphorous, and 0.008% sulfur. It is a truly pre-alloyed metal powder whose original grain boundaries are broken down, leaving a low carbon grain free oxide.

Depending upon the pressures and working conditions, tensile strengths from 29,000 to 65,000 lb. per sq. in. are possible and elongations from 14 to 36%.

Excellent progress is being made in the production of stainless steel filters. The predicted life of the standard 18:8 alloy filter operating at 70 F is 20 yr. in 68% nitric acid, 30 yr. in 10% nitric acid, 3 weeks in 10% sulfuric acid, 5 hr. in 37% hydrochloric acid, 10 yr. in 40% sodium hydroxide, and 40 weeks in 10% phosphoric acid. Another application is cladding surfaces by the Wall-Colmonoy gun or the Powderweld torch. With the powderweld torch there is a flow rate of 1 cu. in. per 18 sec.

There is still a lot of work to be done, but it is believed that stainless steel powder will soon rank alongside the better known pre-alloyed metal powders such as copper-lead and brass. (John D. Dale. Stainless Steel Powder, 14 pp.)

Testing the Forgeability of Steels

Condensed from "Revue de Métallurgie"

A new laboratory test was evolved to determine the proper hot working temperatures for steel. It was felt that the present methods such as bending and compression tests were not satisfactory because their evaluation was too much a matter of personal opinion.

Since it was obviously impossible to duplicate commercial rolling conditions, the elongation at temperature was selected as the most critical factor influencing hot working. An ordinary tensile machine could not be used since the rate of deformation is much slower than the rates encountered in rolling. A constant load machine was developed with which the specimen could be broken in a few seconds. The specimens are heated by the Joule effect. The heating time is about 45 sec. so oxidation is minimized.

The first specimens were cylindrical but it was found that the temperature distribution was not uniform. Consequently, the

DIGEST

ecimen was modified to provide a reduced ction in the middle. The temperature of is section can be regulated quite closely. temperature is measured with an optical rometer. Although this does not give correct temperature, it gives a tempera- e reading comparable to those obtained the rolling mill where similar optical rometers are used. The total test time is out 3 min.

The elongation and reduction of area are otted as a function of temperature. These phs give a quantitative measure of the e of plastic deformation without rupture. us, any critical hot working zones may determined and various steels can be ssified as to their relative hot workability. perience has shown that the minimum the elongation-temperature curve should over 90% for the steel to be rolled isfactorily at all temperatures after an termediate reheating. The agreement of e test results with the behavior in the lling mill is good. (Robert Canard. *Rev. étallurgie* (French), Vol. 43, May-June 46, pp. 156-161.)

Status of H-Steels

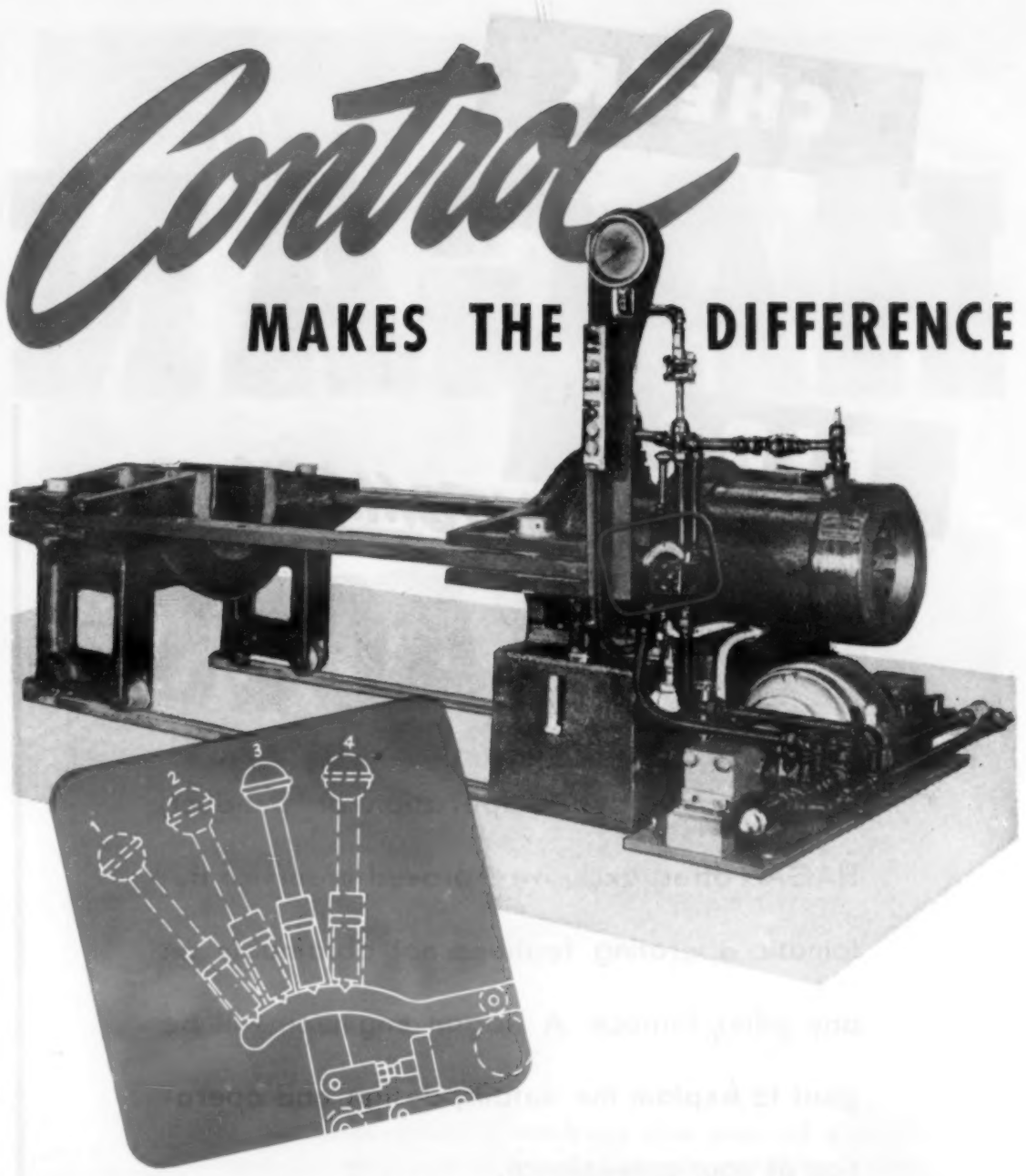
Condensed from a Paper of the American Iron & Steel Institute

The selection of steels according to their rdenability band is resolving the selection alloy steels into more of a science and s of an art based on experience. Through bruary, 1947, more than 1100 alloy steel eats had been reported as produced to H- el chemical composition ranges.

One of the reasons for the lag in general ceptance of H-steels is the firmly estab- shed practice of ordering steel to standard AE-AISI chemical ranges and probably erlooking the fact that the minimum and aximum hardenability values possible with e standard ranges cover a greater spread an that allowed by the corresponding H- eels.

One of the first reactions by steel users H-bands was that the spread between inimum and maximum lines was too wide. ndoubtedly some of the bands need cor- ection and these will be made whenever fficient data are at hand and hardness lues indicate a change is in order.

Steels to H-band compositions have been ost widely accepted by the farm machinery d tractor manufacturers and the producers oil well drilling equipment. These manu- cturers are applying H-steel on quantity oduction parts, processed in continuous eat treating equipment. The carburizing rades, 8620-H, 4812-H, 4815-H and 4817- , are in general use for gears and rock- tting tools where control of minimum d maximum core hardness is essential.



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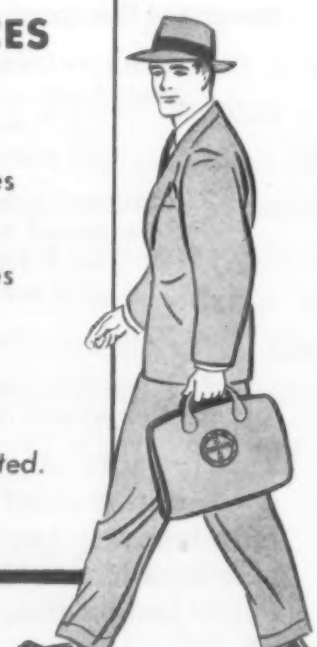

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The automotive industry has recently ordered H-compositions in small quantities. Gears of 8620-H and axle shafts of 4145-H are in production.

A sub-committee of the AISI-Alloy Technical Committee has now undertaken to review the H-bands from two standpoints. First, to study latest information collected on standard compositions and make corrections in the band wherever necessary. Second, to study the possibility of further restriction of the H-bands, based on actual test results of H-steels. (D. H. Ruhnke. Paper, *Am. Iron & Steel Inst.*, May 21-22, 1947 meeting, 11 pp.)

A Resin Adhesive for Light Metals

Condensed from "Light Metals"

Many problems in the design and assembly of light alloys have been solved by the use of synthetic resin adhesives. Welding, riveting, brazing and soldering suffer from many disadvantages, and it is believed that the Redux process, using a synthetic resin adhesive, will overcome many of these difficulties. It can be used to join materials of different compositions and thicknesses. The glue film is a good electrical insulator so electrolytic corrosion is avoided. Redux does not deteriorate with age and maintains its full strength from –40 to +140 F.

In this process, the metal surfaces should be clean and degreased. The liquid resin is brushed on and a white powder sprinkled onto the resin. The parts to be bonded are then firmly clamped together before heating to 285 to 375 F to "cure" the resin.

In a combined sink and draining board, a cast aluminum alloy sink is Redux bonded to an aluminum alloy sheet draining board. All four corners of window frames of aluminum extrusions are bonded simultaneously. In aircraft production, Redux gives worthwhile economy in production costs and a saving in weight. A skin-stiffener panel of Redux will take at least 25% more load than a similar one of riveted or spot welded construction. Another aircraft use is to bond aluminum alloys to wood so each material may be used where it is most efficient. Furniture is made of aluminum frames to which are Redux bonded sheets of veneered aluminum. Duraluminum cycle frames offer a good example of the disadvantages of welding and the advantages of Redux.

A new resin, Aerodux 185, is available which gives quite good adhesion between aluminum alloys and wood at workshop temperatures with only very light clamping pressures. (*Light Metals* (British), May 1947, pp. 234-241.)

BOOK REVIEWS

Mechanics of Materials

MECHANICS OF MATERIALS — SECOND EDITION. *By P. G. Laurson & W. J. Cox. Published by John Wiley & Sons, Inc., New York, 1947. Cloth, 5¾ x 8½ in., 422 pages. Price $4.50.* After being used for eight years as a textbook, it became evident to the authors that certain improvements could be made without altering the character of the book. The new text has been prepared with the expressed aim of achieving a clearer presentation of the subject matter while retaining the original concept of the authors that the ultimate purpose of a book on mechanics (strength) of materials is to prepare the user for an eventual clear understanding of machine and structural design.

As a result, this revised edition contains much re-working of earlier material, such as the chapters on columns which have been re-written and rearranged to simplify the subject; Mohr's circle added to the chapter on Restrained Beams; and the changing of data in nearly all the problems which were retained. There are over 850 problems, many of them based on actual well-known engineering structures and machines.

Some new material has been added, such as Method of Superposition, triangular loading of continuous beams and continuous beams fixed at ends, centroids and moment of inertia of cross sections of sheet metal beams, and tables of deflection of beams.

There are 22 chapters in this new edition, all illustrated, and the text of each one interspersed with problems.

The revision has added appreciably to the book's already recognized value.

Magnesium Fabrication

MAGNESIUM FABRICATION. *By Lothair B. Harkins. Published by Pitman Publishing Corp., New York, 1947. Cloth, 6¼ x 9¼ in., 149 pages. Price $2.75.* This book does not cover the entire magnesium industry—it discusses only the fabrication of wrought materials. It deals principally with the fabrication of magnesium sheets, extrusions, and tubing, usually classed as sheet metal work. The foundry technology of magnesium is not included, though the machining of castings is. Authoritative data for all phases of the fabrication of magnesium alloy sheets, extrusions and tubing into the finished product are presented.

Bowser Chilling Machine T5-150 in use processing sleeve bushings for expansion fitting and hardening brake shoes.

Molecular activity in metals and other materials is greatly retarded when parts of fine assemblies or critical wear materials are chilled to as low as −150° F.

This allows processing for expansion fitting, metal stabilizing, chilling for better machining and cold-tempering of steel and steel-alloy products. Bowser cold processing costs less because no expendable refrigerant is used.

Special application, specification-built, temperature, vacuum and/or humidity units are also designed by Bowser to meet requirements of any size for laboratory, research and processing applications.

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MODEL	Work Capacity Length	Width	Depth	Temp.
T2-45	21″	11″	14″	To −45°F.
T2-60	As Above			To −60°F.
T4-45	23″	21″	14″	To −45°F.
T4-60	As Above			To −60°F.
T5-150	25″	25″	14″	To −150°F.
T11-150	55″	25″	14″	To −150°F.

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Bowser engineers will gladly provide specific information for applying cold processing to assist you in obtaining uniformity and low cost in production or testing operations.

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Write today for catalog sheets. Bulletins are sent to describe units built for PROCESSING, TESTING, RESEARCH, ALTITUDE and HUMIDITY SIMULATION EXPANSION FITTING, COLD TREATING, STABILIZING and other uses. Please specify your choices in your request.

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The Engelhard Flualyzer is a highly sensitive instrument particularly adapted to determining the carbon dioxide content of the generated gas in either oil or gas fired atmosphere type heat treating furnaces. Extremely accurate results are obtained by combination of the time-proven Wheatstone Bridge circuit for the analysis of CO_2 with the Engelhard Thermocouple circuit for the determination of temperature.

Compact and completely self-contained, the Flualyzer is light-weight, portable, easy to handle. Readings are taken directly from a double range indicator calibrated from 0 to 20% of CO_2 and 0 to 1000° F.

A trial will convince you that this modern instrument provides maximum convenience and reliability as a furnace atmosphere test unit.

Write today for details and specific application data.

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An historical review of magnesium metal is included. The book is intended to give the worker, the student and the manufacturer an excellent background and knowledge of the field outside of workaday facts and figures. Attention is called to the fact that a craftsman, trained on aluminum, must learn techniques peculiar to magnesium before he is competent to work the metal. An explanation of these techniques is one aim of the book.

The text is well illustrated. There are 34 titles in the table of contents, some of which are as follows: History and Future of Magnesium; Available Forms; Methods of Joining; Riveting; Heat Treatment; Machining; Cycle, Gas, Arc and Spot Welding; Corrosion Resistance; Pickling; Painting; Scrap; Fire Control; Industrial Contacts; and Technical Data. Most of the titles are only briefly treated.

Other New Books

WELDING SYMBOLS. *By Vincent C. Gourley. Published by Bruce Publishing Co., Milwaukee, 1947. Cloth, 5¾ x 8¾ in., 115 pages. Price $2.50.* Contains the standards and symbols recognized by the American Welding Society.

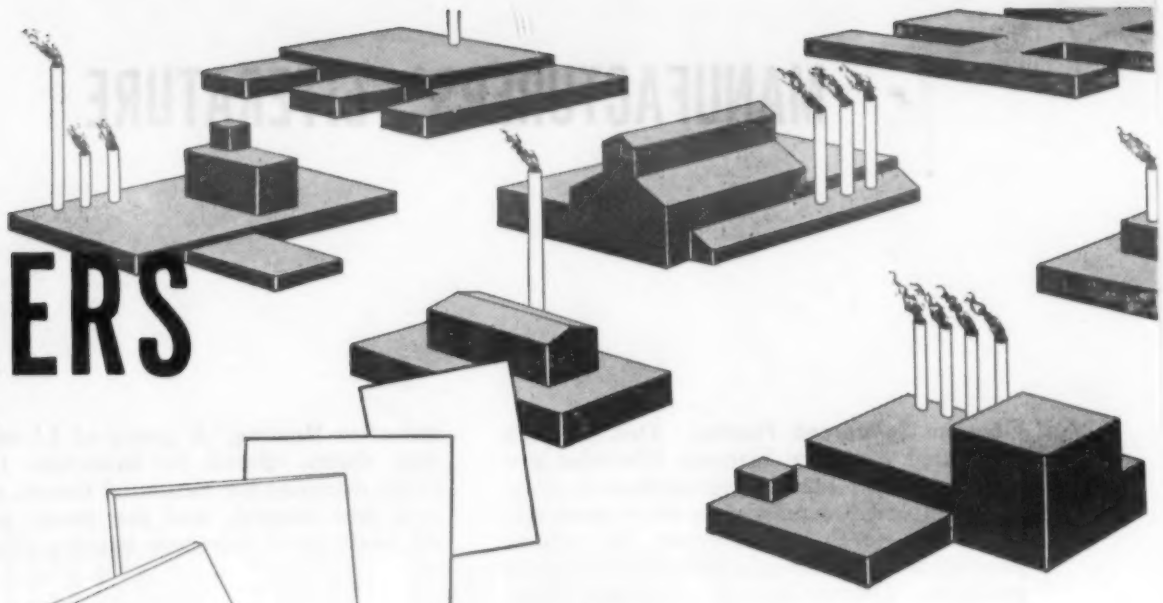
SYMPOSIUM ON TESTING OF BEARINGS. *Published by American Society for Testing Materials, Philadelphia, 1947. Heavy paper, 6 x 9 in., 65 pages. Price $1.50.* Contains five technical papers delivered at the 1946 annual meeting of the society in Buffalo, N. Y., last June. Life testing, fatigue testing and other topics are covered by leading authorities. There are also the discussions of the papers, including questions and answers. The collection is of specific interest to many of those interested in bearing problems.

RADIOGRAPHY IN MODERN INDUSTRY. *Published by Eastman Kodak Co., X-Ray Div., Rochester 4, N. Y., 1947. Fabrikoid, 8½ x 11¼ in., 122 pages. Price $3.00.* This is the work of a number of persons connected with the Eastman Company's research laboratory and with its Industrial X-Ray Div. It has also been augmented by reports of the company's field representatives who serve industries using radiographic equipment. Makers of equipment have also cooperated. The company believes this is "the most complete and authoritative treatment of the subject yet published." It is beautifully illustrated.

A BIBLIOGRAPHY ON DIE CASTING. *By the Editors of "Die Castings" Magazine. Published by Technical Publishing Co., Cleveland, Ohio, 1947. Fabrikoid binder, 9 x 11¼ in., 74 pages. Price $7.50.* A valuable and helpful compilation for those interested in die castings. The bibliographic references are assembled under the following classifications or headings: Alloys; Applications and Uses; Design; Finishing; General; Machines; Process; Properties; and Books and Pamphlets. They cover the period from 1910 to 1946.

RUSSIAN-ENGLISH TECHNICAL AND CHEMICAL DICTIONARY. *By L. I. Callaham. Published by John Wiley & Sons, Inc., New York, 1947. Fabrikoid, 5¾ x 8 in., 794 pages. Price $10.00.* Intended chiefly for English-speaking scientists having a fair knowledge of Russian, and includes a general vocabulary consisting of all types of words that might appear in technical articles. There is no English-Russian section.

PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, VOL. IV, *No. 1. Edited by C. Lipson & W. M. Murray. Published by Addison-Wesley Press, Inc., Cambridge 42, Mass., 1946. Cloth, 8¾ x 11¼ in., 129 pages. Price $6.00.* This volume contains 12 technical papers on a variety of subjects, presented before the society. They are fully illustrated. It also contains a list of all the members and one of the corporation members.



MANUFACTURERS LITERATURE

Materials

IRON AND STEEL

Manganese-Nickel Steel. The prices of a complete list of Manganal (manganese-nickel steel) welding electrodes, applicator bars, cast wedge bars, and hot rolled plates for the conservation welding of manganese, carbon and alloy steel parts are included in a 4-page, illustrated bulletin distributed by Hulz-Sickles Co. (1)

NONFERROUS METALS

Yield Strength Calculator. A handy, compact yield strength calculator for aluminum alloys, brass, copper, and carbon and low alloy steels is offered by the Aluminum Research Institute for the sum of $1.00. (2)

Aluminum Alloys. The facilities of the Bohn Aluminum & Brass Corp., Aluminum Refiners Div., for refining aluminum alloys are profusely illustrated and described in a 48-page catalog. Thermal, electrical and mechanical properties, and specifications of aluminum alloys are included. (3)

Aluminum Alloy. The history, features, recommended applications, and mechanical and physical properties of Allcast Aluminum Alloy SC8, produced by the National Smelting Co., are presented in this revised 8-page, illustrated bulletin. (4)

Powdered Metal. A comprehensive, 260-page catalog just published by the U. S. Graphite Co. describes and illustrates a new powdered metal product, Gramix, for use in powdered metal parts manufacture. (5)

PARTS AND FORMS

Precision Molded Gears. Complete data on precision injection molded Nylon gears, which eliminate troublesome lubricating problems, weight in assemblies, and rust, are presented in four illustrated data sheets offered by Atlantic Plastics, Inc. (6)

Locking System. The Rosan locking system for threaded inserts and studs in metals, plastics or wood is fully discussed in a 12-page, illustrated bulletin issued by Bardwell & McAlister, Inc. Specifications are included. (7)

Steel Plate Shapes. The facilities of the By-Products Steel Corp. for producing a variety of flame-cut, sheared, pressed, bent, blanked and welded steel plate shapes are described in this profusely illustrated, 12-page bulletin. (8)

Hard Rubber Products. Specifications, properties and typical applications of a variety of hard rubber sheet, rod and tubing products are included in this 4-page, illustrated bulletin, No. 9405, issued by the B. F. Goodrich Co. (9)

Die Castings. The facilities of the Harvill Corp. for producing zinc, aluminum, magnesium and brass die castings, and the industries they serve, are profusely illustrated and described in this 8-page bulletin. (10)

Clad Steels. A wide variety of recommended applications for nickel-, Inconel- and Monel-clad steels are profusely illustrated and described by Lukens Steel Co. in a 36-page catalog, No. 255. Specifications are included. (11)

Wrought Fittings. Bulletin No. 901 of the Northern Indiana Brass Co. describes and illustrates a variety of Nibcoloy stainless steel and nickel alloy fittings from ¼-in. O.D. to 4-in. O.D. Roughing-in dimensions and prices are included. (12)

Self-Locking Nuts. This 2-page, illustrated reprint of the Nylock Corp. features the Nylock Nut, a new self-locking nut with nylon as the locking element that locks the bolt and nut so they can't shake loose. (13)

Bolts, Nuts, Studs, Etc. This 28-page, indexed catalog, No. 46, gives a complete price list of brass and bronze bolts, screws, nuts and washers, silicon bronze bolts, nuts and washers, stainless steel bolts, nuts and washers, and Monel metal bolts and nuts, all produced by the Pawtucket Mfg. Co. (14)

Screw Machine Products, Etc. The facilities of the Perry Metal Products Co., Inc., for the development and production in metals, plastics and rubber of screw machine products, metal spinning and stamping, special shapes, etc., are discussed in a 2-page, illustrated bulletin. (15)

Seamless Tubing. A stock list, complete with prices, of 101 sizes of Electric Furnace 52100 seamless tubing is offered by the Timken Roller Bearing Co., Steel & Tube Div. in an 8-page, illustrated bulletin. (16)

PLASTICS

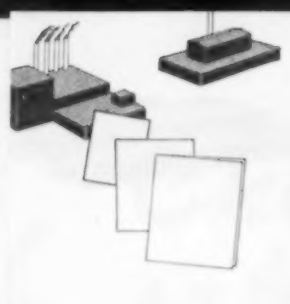
Plastics. The electrical, thermal and chemical properties of Amphenol No. 912-A polystyrene, Amphenol No. 912-B acrylics, and Amphenol No. 9746 flexible synthetic tubing are included in this 8-page, illustrated bulletin published by American Phenolic Corp. (17)

Pre-Formed Molding Compounds. Complete data on pre-formed phenolic impact molding compounds that are shaped in sizes, shapes and weights to meet specific requirements are presented in a 4-page, illustrated bulletin offered by Drackett Products Co. (18)

Molded Plastics. The advantages of the Firestone Industrial Products Co.'s plastics molding service for a variety of industries are featured in an 8-page, illustrated bulletin. (19)

Laminated Plastics. Complete data on the manufacture, application engineering and properties of all types of Textolite laminated plastics are presented by General Electric Co. in a 64-page, illustrated catalog. (20)

Reactive Compound. Complete technical data on vinyl cyclohexene, a reactive compound suggested for investigation as a raw material for producing resins and plastics, are presented by the Chemical Div. of Koppers Co., Inc., in a 2-page bulletin, No. N-9851. (21)



MANUFACTURERS' LITERATURE

Methods and Equipment

HEAT TREATING

Cast Iron Cylinder Liners. An interesting article on the treatment of alloy cast iron cylinder liners for automotive engines, both gas and diesel, is offered by the Ajax Electric Co., Inc., in a 4-page, illustrated reprint. (26)

Industrial Furnaces. A complete line of continuous hardening and tempering furnaces, oil and spray quenches, heat treating furnaces, ammonia dissociators, etc., produced by the Drever Co. is profusely illustrated and described in a 16-page bulletin, No. B-31. (27)

Gas-Fired Furnaces. A variety of Gasmaco fuel-fired high temperature furnaces for all types of heat treatment are described and illustrated in a 4-page bulletin, No. A-100, issued by the Gas Machinery Co. (28)

Induction Heating. A group of 11 technical data sheets offered by Induction Heating Corp. discusses the elemental theory, production and control, and the many practical applications of induction heating principles. (29)

WELDING

Resistance Welding Electrodes and Alloys. The properties, applications, stock sizes and recommended electrode materials of a complete line of spot welder tips and holders, seam welder wheels, etc., produced by Ampco Metal, Inc., are tabulated in a 24-page, illustrated bulletin, No. 68B. (30)

Welders and Brazers. A complete line of air and foot operated spot and butt welders, brazers, portable gun and portable brazer is presented in a 4-page, illustrated bulletin, No. G1-47, issued by Banner Products Co. Specifications are included. (31)

Silver Brazing Alloy. The many advantages of using Easy-Flo 45, a modern, versatile silver brazing alloy for use in metal joining, are featured in a 4-page, illustrated bulletin, No. 15, offered by Handy & Harman. (32)

Arc Welding Electrodes. A complete line of shielded-arc electrodes for the welding of mild steels and alloy steels is presented in a new catalog just published by the McKay Co. Specifications, applications, mechanical properties, etc., are included. (33)

A. C. Welders. Complete data on a variety of a.c. welders for "Heliarc" welding are presented by the Miller Electric Mfg. Co. in a 4-page, illustrated bulletin. Specifications and prices are included. (34)

Stud Welders. Typical applications, physical properties, etc., of a variety of electric arc stud welders are included in this 40-page, profusely illustrated catalog issued by the Nelson Sales Corp. (35)

Hard-Facing Alloys. This 4-page, illustrated bulletin issued by the Stoody Co. discusses Coated Stoody 6 and Coated Stoody 1, two cobalt-chromium-tungsten alloys for a.c.-d.c. electric applications involving abrasion, heat, corrosion and impact. (36)

FORGING AND FORMING

Hydraulic Presses, Pumps, Etc. Specifications and dimensions of a complete line of compression and transfer molding presses, pumpless and motorless power presses, horizontal and vertical pumps, etc., for the plastics industry is presented by Elmes Engineering Works of American Steel Foundries in a 12-page, illustrated bulletin, No. 5200. (37)

Tube Fabricating Equipment. A complete line of production tube benders and accessories, hand benders, cutters, flaring tools, etc., produced by the Parker Appliance Co. is described and illustrated in a new bulletin, No. 401. (38)

Hole-Punching Units. This 16-page, illustrated bulletin, No. CD—third edition—published by Wales-Strippit Corp., describes and illustrates Type "CD" hole punching units for punching mild sheet metal up to 1/8-in. thick. (39)

MACHINING

Automatic Cam Feed Units. A variety of direct motor, gear motor and vee belt motor drive automatic cam feed units for vertical, horizontal or angular drilling, tapping, reaming and hollow milling applications are described and illustrated in a 20-page bulletin, No. 645, issued by Avey Drilling Machine Co. (40)

Abrasive Wheels. Complete data on a variety of Besly-Titan abrasive wheels, including a price list, are presented by Chas. H. Besly & Co. in a pocket-sized, 48-page, illustrated handbook. (41)

Lathes, Planers, Drill Presses, Etc. The engineering and production facilities of Lake Erie Engineering Corp., manufacturers of a variety of lathes, planers, drill presses, horizontal and vertical boring mills, as well as hydraulic presses, are profusely illustrated and described in a 16-page bulletin. (42)

Centerless Grinding Machine. Specifications and diagrams of the No. 12 centerless grinding machine are included in this 16-page, profusely illustrated bulletin, No. T-47, offered by Landis Tool Co. (43)

Grinding Wheels. This 32-page, illustrated booklet published by the Norton Co. presents complete data on a variety of grinding wheels for foundries, steel mills, forge and welding shops. Specifications and list prices are included. (44)

Profilers. A variety of automatic and semi-automatic profilers for such operations as centering, drilling, burring, boring, turning, facing, etc., on one or both ends of tubes and rods are described and illustrated in a 4-page bulletin offered by Pines Engineering Co., Inc. Specifications are included. (45)

FINISHING

Deburring Equipment. How to cut the production costs of deburring and finishing stampings, castings and machined parts by using the deburring equipment illustrated in this 4-page bulletin is discussed by Almco, Inc. (46)

Filters for Plating Solutions. Complete data on the use of "Sealed-Disc" filters for electroplating solutions are presented by Alsop Engineering Corp. in a new, illustrated bulletin. (47)

New Materials and Equipment

Atmosphere Furnaces Use Balanced Carbon Principle

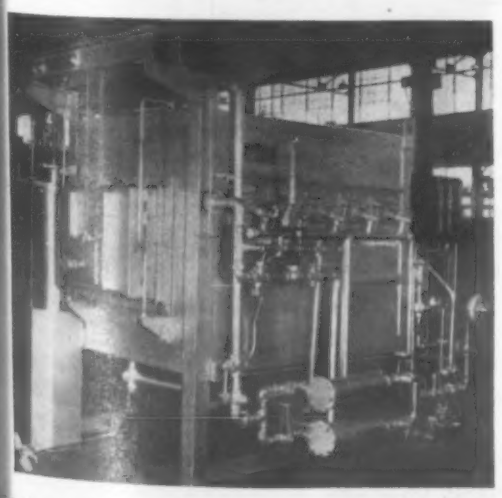
Two new prepared atmosphere furnaces have been added to the line of heat treating furnaces of *Surface Combustion Corp.*, Toledo 1, Ohio. They are the Balco atmosphere furnace and the Balco gas carburizing furnace.

Both of these new furnaces utilize this company's RX gas as the protective atmosphere. With this gas the carbon potential can be controlled to be in balance with a desired carbon content of steel, and makes possible a scale free, heat treated product with a selected surface carbon content.

The atmosphere furnaces are of the horizontal muffle type, externally fired, with the gas generator built as an integral, but separately heated, part of the unit. They are of two general types: Superheat, Series BRS (2000 to 2400 F) and General Heat Treat, Series BRG (1400 to 1850 F). For operation at lower temperature the latter series can be modified by the addition of pilots for off-on operation.

The carburizing furnaces may be used for heat treating all types of steel in a balanced carbon atmosphere, as well as for gas carburizing. The units are also of the horizontal muffle type, externally fired with the generator included as an integral, but separately heated, part in the rear of the furnace casing. An atmosphere recirculating system with an electric driven pump draws the atmosphere from the front end of the muffle, through a filter, and reintroduces it into the rear of the muffle under pressure.

The furnace operates at a temperature from 1400 to 1850 F and can be heated from cold in about 2½ hr. The rate of carburizing for S.A.E. 1020 steel at 1700 F ranges from 0.94 hr. for a case depth of 0.020 to 12.00 hr. for a case depth of 0.070 (measured to core analysis).



The furnaces utilize a selective double door to minimize the loss of temperature.

Silver Powder Has High Purity and Density

A silver powder, chemically precipitated, white in color, free flowing, and of high purity (99.97% pure), is being produced by *Alloymet Manufacturing Co.*, 3 Grand St., Brooklyn. It contains no free acids or alkalies and is said to be unusually gas free.

The particle size distribution is from —200 to +400 mesh. The grains are in a fully annealed condition, and therefore not work hardened nor do they have burnished surfaces. These particles are very irregular in shape, possessing many hooks and arms, thus producing an interlocking effect upon pressing, which gives compacts a high green strength. The lack of micron size particles minimizes the loss of powder through dusting, during the pressing operation.

The powder, known as Type MR 3 Fine Silver Powder, possesses high density which causes it to flow readily into odd shaped dies. This high density is said to allow the use of a die shallower than would otherwise be used with ordinary types of silver powder, thus decreasing die costs and allowing the production of thicker parts on standard fill presses. The tap density of this powder (as obtained on the Tap Flow Meter) is 48.76 gms. per cu. in.

Sludge Tanks Are Self-Cleaning

Two self-cleaning sludge tanks with pipe conveyors having synthetic rubber flights mounted on sealed pin chains are available from *Hapman Conveyors, Inc.* of Detroit 21.

These pipe conveyors will operate in any plane. A departure from ordinary tanks is the double "V" bottom which permits rapid sludge settling and quick removal. A series of five baffles retards the coolant flow uniformly over the tank area providing maximum sludge settling capacity.

A single sprocket with shear pin mounted on a combination drive and take-up assembly represents the only fixed moving part. The chain elsewhere in the circuit follows the bent pipe in several planes.

Power required to operate conveyors is small, 1/6-h.p. for the junior size and 1/3-h.p. motor for the standard size sludge tank.

These tanks are suitable for any non-corrosive sludge which will readily settle. Quench tank scale, machine tool coolant settlings, and abrasive precipitates are typical materials handled. Temperature is limited to 270 F. The junior size has a coolant capacity of 400 gal., while the standard size capacity is 3200 gal.

New Die Caster Has Large Casting Area

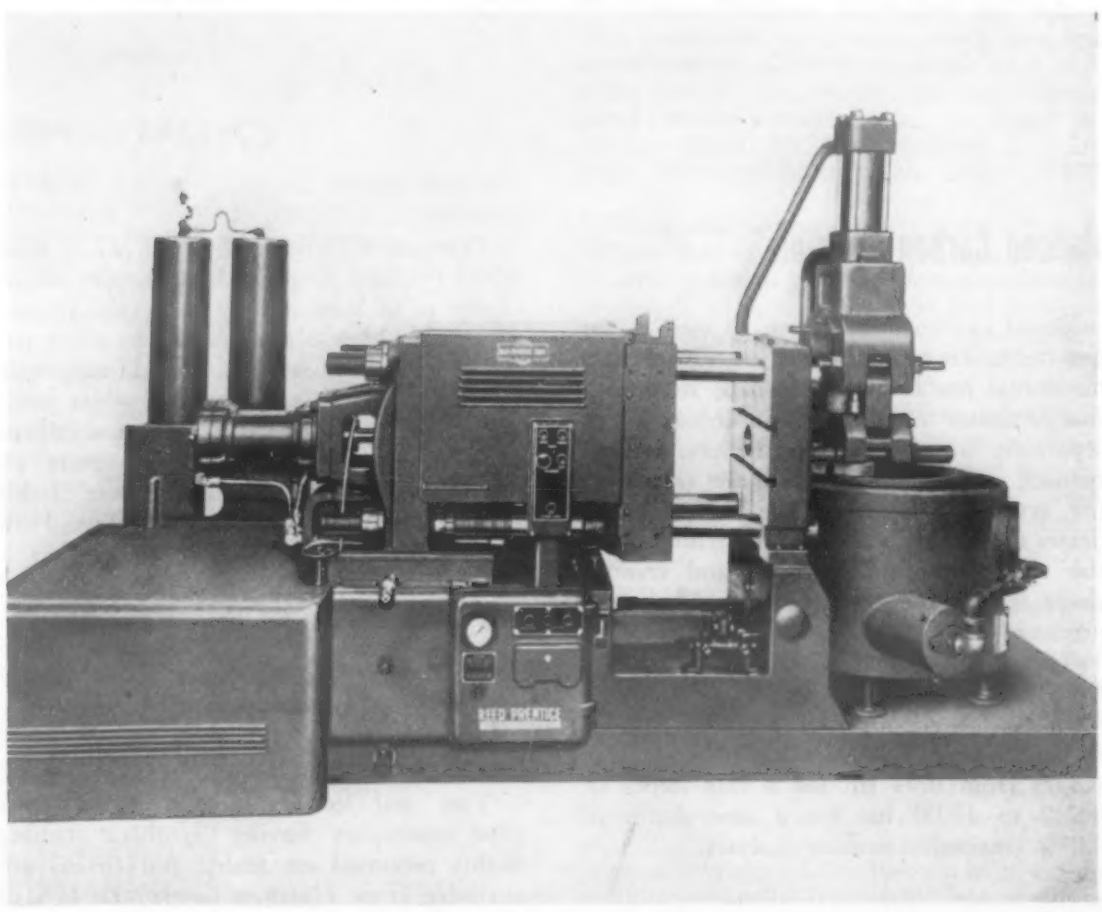
A new machine for die casting of lead, tin or zinc base alloys has been designed by *Reed-Prentice Corp.,* Worcester 4, Mass. It offers a large casting area with die plates 38 by 36 in. and space between bars 24 by 24 in. Sixteen pounds of zinc may be cast at 1400 lb. per sq. in. pressure.

The operation of the machine is either manual or semi-automatic. For semi-automatic operation, dies are closed manually by the push buttons on control panel after which the remainder of the cycle is automatic and controlled by an adjustable electric timing device. When manually operated, the four push buttons on the control panel are used. The upper two open and close the dies; the lower two actuate the plunger.

The machine is electrically interlocked, eliminating all danger of shooting the metal until the dies are securely closed. Arrangements are made for automatic ejection of castings. Die plates are finished on sides to provide for core pulling attachment and push button operated control valve is provided to actuate core pulling cylinders when they are used.

The furnace is cylindrical. This permits a new gooseneck design, allowing easy removal of the gooseneck and nozzle. The round type melting furnace also provides increased pot life because of tangential firing and elimination of stress points caused by rectangular corners.

This No. 2 model is also available with horizontal plunger and cold chamber attachment for die casting of aluminum, magnesium, or brass alloys.



The die casting machine may be operated either manually or semi-automatically.

Resin Adhesive Sets at Room Temperature

A new resin adhesive, known as Durez 13793, for assembly or secondary gluing which sets at room temperature and has a 1-hr. assembly time has been announced by *Durez Plastics & Chemicals, Inc.,* of North Tonawanda, N. Y. This adhesive is used for gluing hard or soft wood, sheet asbestos, foamed glass, phenolic laminates, vulcanized fibre, etc., and is said to meet all specifications which require a durable, boilproof adhesive that sets at temperatures of 70 F or higher.

The adhesive is a water soluble liquid resin which has more than six months storage life in sealed containers. It is used with a powdered hardener, Durez 12689, and will also carry extra filler and water without impairing its bonding qualities.

Where immediate application of pressure is not practical or desirable, the manufacturer states that tests indicate a maximum open assembly time of 1 hr. and closed assembly time of 2½ hr. at 70 F, or ¾-hr. open assembly and 1¾-hr. closed assembly at 90 F. Maple block shear tests at these assembly times reveal at least 2800 psi.

Pneumatic Operating Equipment for Drill Presses

Pneumatic operating equipment for installation on drill presses used for production drilling has been developed by *National Pneumatic Co.,* Rahway, N. J.

The equipment supplied in the form of a kit consists of an operating assembly (including air engine, pressure gage, pressure regulator, exhaust valve and cushioning plug), together with foot-operated control valve, air strainer, cut-out cock and flexible hose.

The engine provides controlled air power which can be adjusted to suit any drill size or stock and to permit maximum drilling pressure and speed within safe limits.

By use of this equipment a hand operated press can be converted to power operation, thereby reducing costs and increasing operator efficiency. The foot control leaves the operator's hands free, resulting in faster loading and unloading of fixtures.

● The *Curtis Universal Joint Co., Inc.,* Dept. D, Birnie Ave., Springfield 7, Mass., has developed a ball-type industrial universal joint that is said to be ideal for high speeds at light loads. The forks of this new ball-type joint are steel and bear on a bronze ball, with heat-treated centerless ground pivot bearing pins. Two sizes of joints—½-in. dia. and ¾-in. dia.—are now available.

Broaching Machine Features Slow Ram

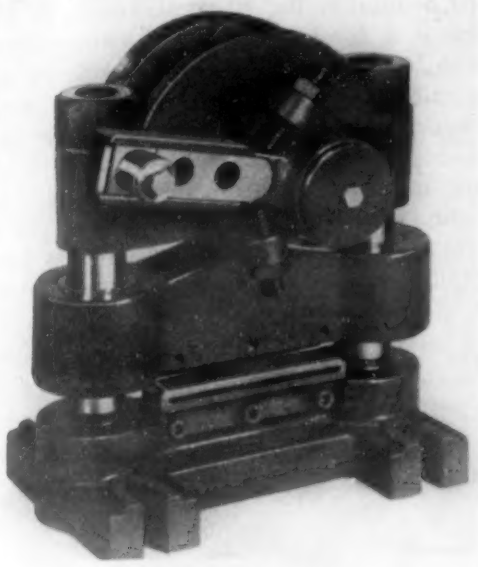
Setup time is said to be cut with a new double-cylinder 36-in. stroke hydraulic broaching machine manufactured by *Zagar Tool Inc.,* 23880 Lakeland Blvd., Cleveland 17.

Slow ram speeds without loss of pulling power are made possible by an oil control valve. The return stroke is constantly fast. Pulling power equals 16,000 lb. Close selection of speeds is permitted by controls. It is equipped with 220/440 v., 3 phase, 60-cycle motor—wired to suit available current.

The design of this broaching machine is compact and saves floor space.

Scrap Cutter Designed for Use With Punch Press

A ram-driven scrap cutter which can be used on almost any punch press has been announced by *Haller Machine & Mfg. Co., Inc.*, 7940 Tireman Ave., Detroit 4. This



This ram-driven scrap cutter offers economies through greater ease of scrap handling.

unit will cut stock to 4-in. width and 3/32-in. thickness.

Known as the Model D-611 Scrap Cutter, this unit measures 6½ in. wide by 9¼ in. deep by 10 in. high over all. It is mounted on the bolster plate of the press, is driven directly from the ram or die, and is adjustable for any length of ram stroke up to 6 in. The high-speed steel blades can be removed for sharpening and are replaceable.

Heat Treating Unit Provides Automatic Control

A new automatic heat treating unit has been developed by *Ipsen Industries, Inc.*, Rockford, Ill. The unit consists of an automatic batch-loading, continuous unloading furnace mounted directly on an automatic-unloading quench tank. A controller regulates the heating cycle and the quench.

Typical parts that can be heat treated with any desired atmosphere are stampings, screws, bolts, springs, and machined parts. The unit is designed for oil, water and brine quench mediums and with special adaptation can be used for martempering and austempering.

With correct atmospheres, steels requiring as high as 1750 F may be heated for neutral, bright annealing, or carburizing treatments.

The equipment is made in one standard size furnished with gas or electric heat. The hearth dimensions are width 24 in., depth 36 in.

Hydraulic Press Features Gap Type Frame

A 20-ton gap frame hydraulic press has been designed by the *Northern Tool & Machine Co.*, 1120 N. 31st Ave., Melrose Park, Ill. Of all steel welded construction, this unit has 8 in. of throat, 12 in. stroke and a platen 12 by 17 in.

A stroke selector enables the operator to adjust quickly the stroke length by tightening a thumb screw. The press has a hard chromium finished ram, tonnage control adjustable up to 20 tons, and pressure holding valve.

It is adapted to all metal forming operations such as drawing, bending, straightening, forcing, riveting, crimping, piercing, staking and assembly.

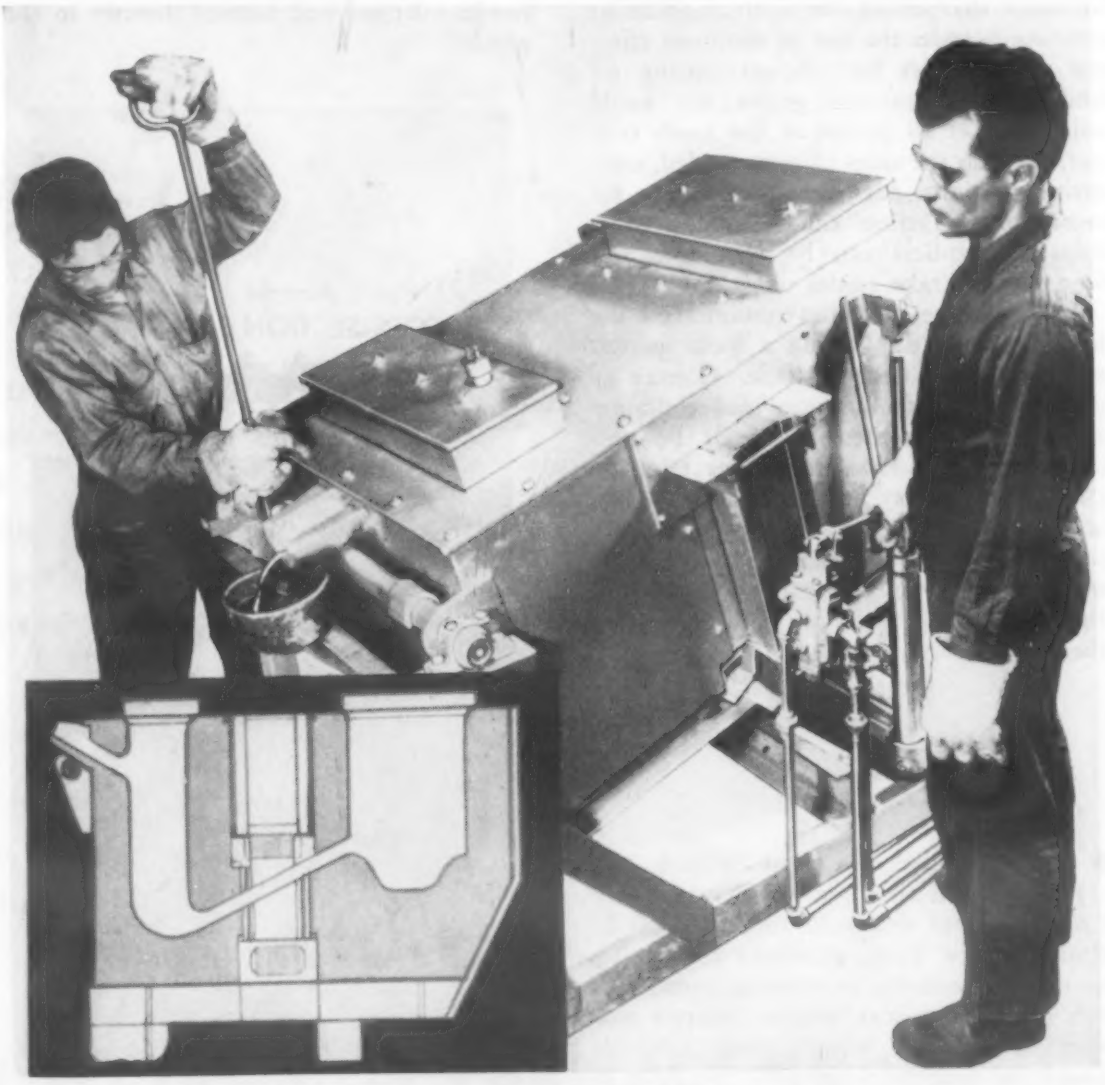
Induction Melting Furnace Permits Continuous Pouring

An induction melting furnace for aluminum, brass and zinc that permits continuous pouring has been announced by *Fisher Furnace Div., Lindberg Engineering Co.*, 2444 W. Hubbard St., Chicago 12. Two chambers, connected by a series of straight line melting channels, replace the usual single chamber. One chamber is for charging, the other for pouring.

The manufacturer claims the following advantages: Metal in pouring chamber is always at pouring temperature; adding cold metal to the charging chamber does not affect temperature in pouring chamber, within reasonable operating limits; only clean residue-free metal reaches pouring chamber, as all residue either floats at surface or sinks to bottom of charging chamber; straightline melting channels permit cleaning by means of simple cleaning rod.

Both chambers are refractory lined and do not require crucibles or pots. Operation is cooler as induction heating heats metal only, and not the entire furnace. Covered chambers prevent heat radiation except when charging or ladling.

These furnaces are available in 100, 300, 500 and 1000 lb. per hr. melting capacities.



The cut-away view shows the principal features of this two-chamber induction melting furnace.

Contour Cutter Sharpening Machine

A machine for the sharpening of contour-ground form milling cutters has been announced by the *Cincinnati Milling Machine Co.*, Cincinnati 9, Ohio.

Designed to enable the user of form milling cutters to benefit by the many advantages of the contour-ground type of cutter as opposed to the conventional form relieved type of cutter, cutters are sharpened by grinding on the formed profile of the cutting edge instead of the flat rake face of the tooth.

The contour ground tooth retains its original shape and strength with repeated sharpenings, whereas form-relieved teeth

With this contour cutter sharpening machine advantages of the contour-ground type of cutter are achieved.

become narrower and weaker with each successive sharpening. In addition, contour grinding permits the use of the most effective tooth shapes for efficient cutting action; correct clearance angles are easily maintained at all points of the tooth contour, even on the sides of steep-angled, side-cutting portions; adequate helix angles for freest cutting action can be used; wide, deep chip gullets can be provided; and most effective rake angles used.

This machine generates contours on the cutter teeth by duplicating a metal master template of the desired shape. Convex or concave radii, angular faces, and combinations of these elements may all be produced. Since wear on the master template is negligible it may be used indefinitely, as long as there is a need for cutters of that particular shape. The template holder is equipped with adjusting screws to simplify alignment of the template with the cutter when setting up.

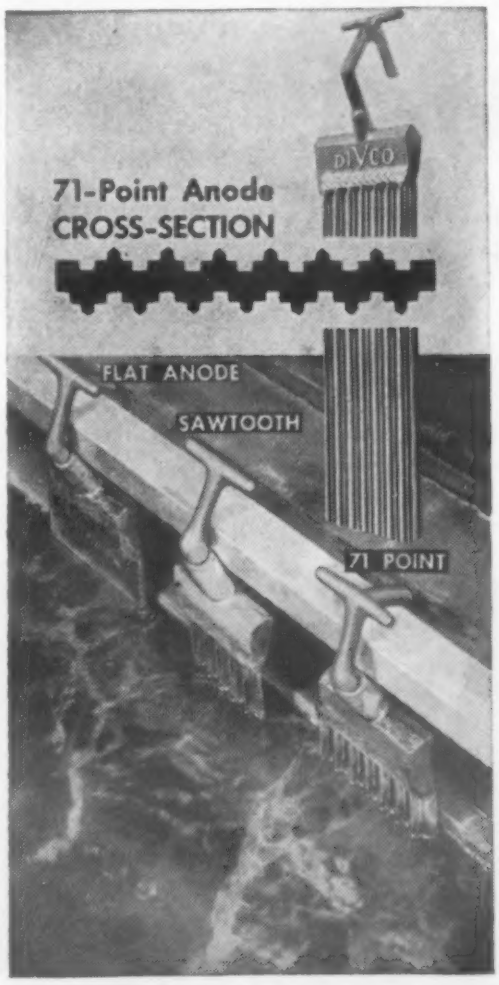
● The new and improved Wilson No. 524 all-position electrode was developed by *Wilson Welder & Metals Co., Inc.*, 60 E. 42nd St., New York, primarily for use by the aircraft industry in welding assemblies such as landing gear, engine mounts and other vital parts where great strength gained by heat treating after welding is desired. Tensile strengths up to approximately 150,000 psi. can be obtained when the deposited metal is heated to 1600 F, quenched in oil and drawn at 600 F for 1 hr. Though primarily designed for the aircraft industry, this electrode can also be used on alloy steels where high tensile strengths are required.

New Lead Anodes Have Sawtooth Design

The appearance of massive bumpers and grillwork on post war automobiles has resulted in the need for larger plating anodes. A new heavy-duty anode adaptable for fast plating of heavy metal work has been designed by the *Heil Process Equipment Corp.*, Cleveland. This lead anode is over 5 ft. long and is of sawtooth design to increase its current carrying capacity. The anodes come with special hooks for hoisting in and out of tanks.

The *Division Lead Co.*, 836 W. Kinzie St., Chicago 22, has also announced a new lead anode. It has 71 points. Arrangement of the points concentrates gassing to create a rapid flow of solution against the surface. Stagnation is said to be eliminated even down to the bottom of the troughs; the great surface area and the 71 throwing edges are fully utilized. Disintegration is uniform over the entire surface, and the anodes retain high efficiency through their service life.

The anodes are extruded of antimonial lead. The deep-ribbed construction prevents warping and buckling. The bronze hook is hot-lead-dipped and burned directly to the anode.

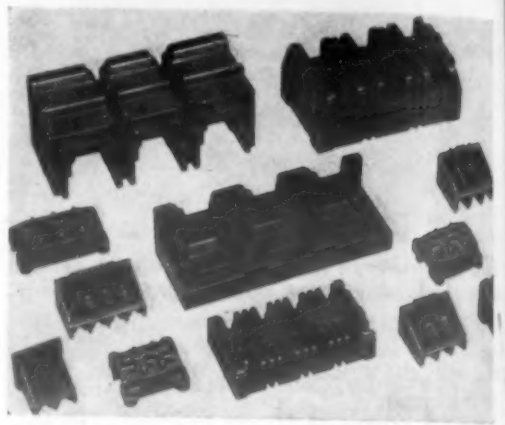


The 71-point lead anode with a cross-section showing its construction.

Inorganic Plastic Material for Electrical Applications

Application of an inorganic plastic material, to the molding of products in the electrical, architectural, general industrial, and consumer goods fields has been announced by *Rostone Corp.*, 159 S. Earl Ave., Lafayette, Ind.

Chemically, the material known as Rosite is a form of calcium alumino-silicate with a microcrystalline grain structure integrally reinforced with asbestos fibre. Physically, it possesses many of the desirable characteristics inherent in a stone-like material. It is unaffected by oil, sunlight, alkali, age, and temperatures up to 900 F. Compressive strength ranges from 12,000 to 15,000 psi. with a modulus of



Examples of the complex types of electrical moldings that are produced with Rosite.

rupture of from 5,000 to 7,500 psi., depending on the particular formulation used. Its weight is approximately 0.058 psi. There is no cold flow and no distortion with age.

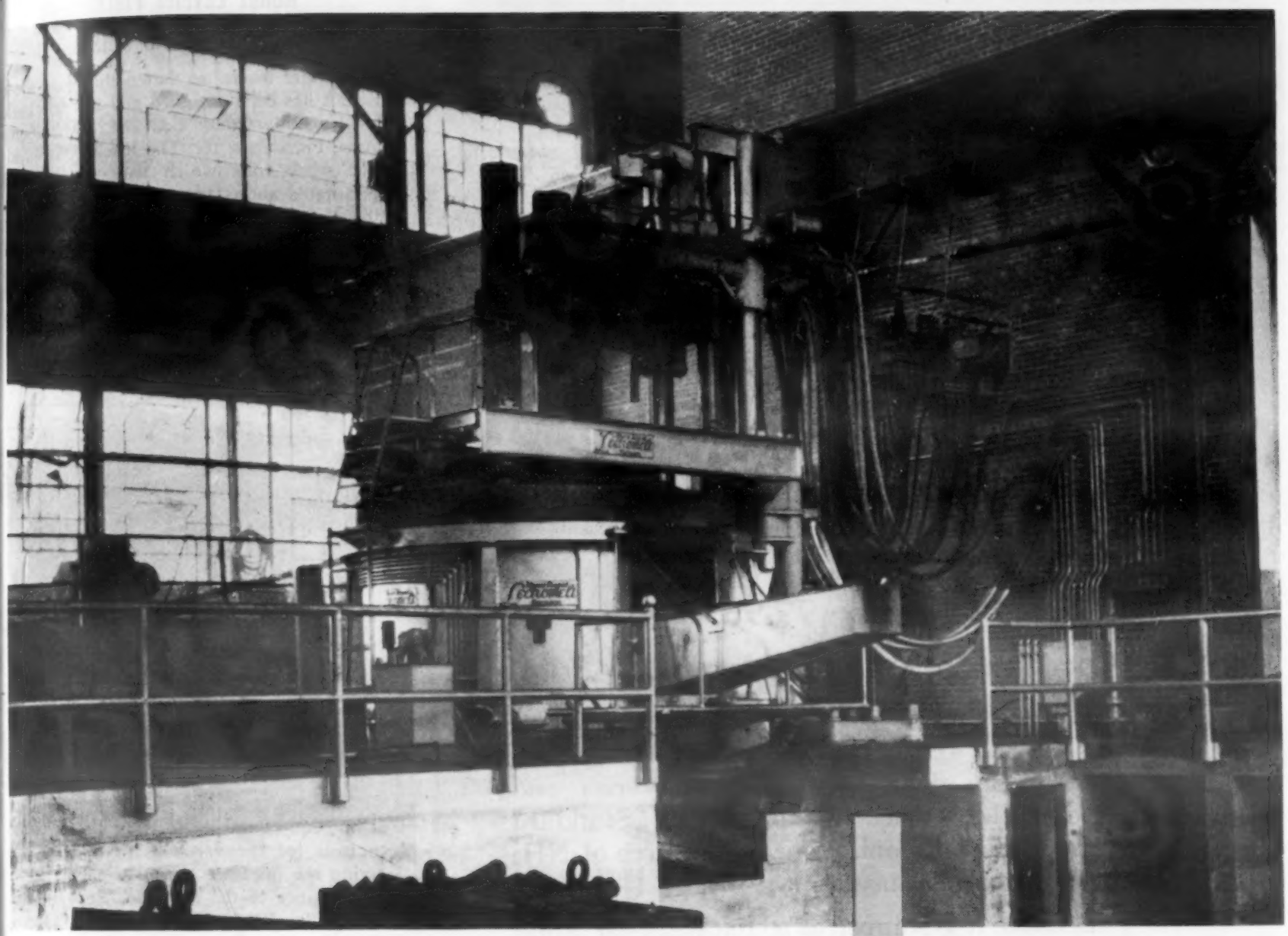
Due to non-carbonizing and heat resisting characteristics, this material has seen use in the electrical field for circuit-breaker housings, switchboard panels, thermostat bases, terminal blocks, grid spacers, fuse blocks, and similar products. For electrical applications, the moldings are impregnated with moisture-proofing waxes to maintain dielectric strength.

Power Press Can Be Used as Lifting Jack

A new hydraulic power press built in 8- and 20-ton capacities has been announced by *Aristo Power Tools, Inc.*, 601 W. Washington Blvd., Chicago 6. With this power press the power unit can be removed and used separately as a portable lifting jack. The 8-ton capacity press incorporates an 8-ton jack, specially designed for inverted operation in the press.

The 20-ton press incorporates a 20-ton power unit. This piece of equipment is detachable from the press crown for use as a portable jack for a variety of lifting, pulling, pushing and clamping operations.

The 8-ton press has an arc-welded frame capable of withstanding a 20-ton load. The 20-ton press has an arc-welded frame capable of withstanding a 50-ton load.



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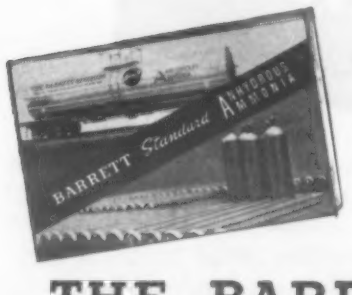
Modern metallurgy is finding more and more uses for Barrett Standard Anhydrous Ammonia. The advice and help of Barrett technical service men are yours for the asking.



This interesting and helpful booklet is packed with useful information on Anhydrous Ammonia. You can obtain a copy without charge or obligation, by requesting it from the address below.

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Roller Leveler Flattens Thin-Gage Sheets

A roller leveler to flatten thin-gage sheet metals has been designed and recently built by *Voss Machinery Co.*, 2882 W. Liberty Ave., Pittsburgh 16. The leveler has ¾-in. dia. work rolls which flattens alloy and perforated sheets from 0.010- to 0.030-in. thick and up to 28 in. in width.

To bring about the correct flattening of the sheets, all controls are from levers mounted on the top of the machine and hand-wheel located below them, all placed

This roller leveler was designed for thin-gage sheet metals that cannot be leveled by conventional type machines.

at one end of the leveler near the electrical controls for the variable speed drive and giving the operator control over the entire performance of the machine.

This leveler is known as the Inverted Type Leveler. Due to simplified construction, the lower flight of rolls is tiltable and not the upper flight of rolls, as is the usual form of construction and design.

Portable Welder for Shop and Field Service

A new self-powered arc welder, designed for shop, yard and field service, is offered by *Harnischfeger Corp.*, 4400 W. National Ave., Milwaukee, Wis. Known as Model WN-200, it is available as a stationary or trailer unit, is an N.E.M.A. rated machine of 200 amp., but has a welding service range of from 30 to 260 amp.

There is just one control for any desired welding heat from minimum to maximum capacity. Arc response is automatic on all classes of work and with all types of electrodes.

Rated 30 v. at 2900 rpm., the generator is self-excited by a set of auxiliary brushes mounted on a brush holder rocker in advance of the main brushes. The armature is dynamically balanced and is supported on each end on large grease lubricated ball bearings. Windings are especially treated to withstand heavy overload and internal operating stresses.

No Water Connections Required for New Induction Heater

A bench type machine designed primarily for silver brazing and soldering, but also adaptable to hardening, annealing and forging applications within its power capacity, has been announced by the *Tocco Div., Ohio Crankshaft Co.*, 3800 Harvard Ave., Cleveland.

The new unit is of the tube oscillator type, 750 w., 450,000 cycle. It operates from a 110/120-v. a.c. single-phase 60-cycle current source and is tapped to accommodate either single or multiple-turn inductor coils. A unique feature is that the unit requires no water connections.

This small Toccotron unit is suitable for both automatic or manual operation. It is designed to operate continually at full load for mass production work, but is adaptable to set-up changes required by job-shop or tool room operations. Inductor coils can be made by simply forming copper tubing or wire to the required shape.

Piercing Unit Suitable for Multiple Hole Piercing

A new hydraulic piercing unit that pierces all holes in the flanges of a refrigerator door in one 7-sec. operation, has been developed by the *Vulcan Tool Co.*, 730 Lorain Ave., Dayton, Ohio. The unit, requiring one operator, is said to perform the over-all job formerly requiring four individual piercing operations. This piercing principle can be adapted to practically any operation requiring multiple hole piercing.

The unit pierces a total of 55 holes in the four flanges of an 8-ft. refrigerator door. All door sizes can be accommodated.

This piercing unit combines four separate piercing operations in one.

The change-over from one size to another requires approximately 1 hr.

This unit is also flexible in that it can be used for either right or left hand doors simply by changing the punches for the hinge holes. This change-over can be made in a few minutes.

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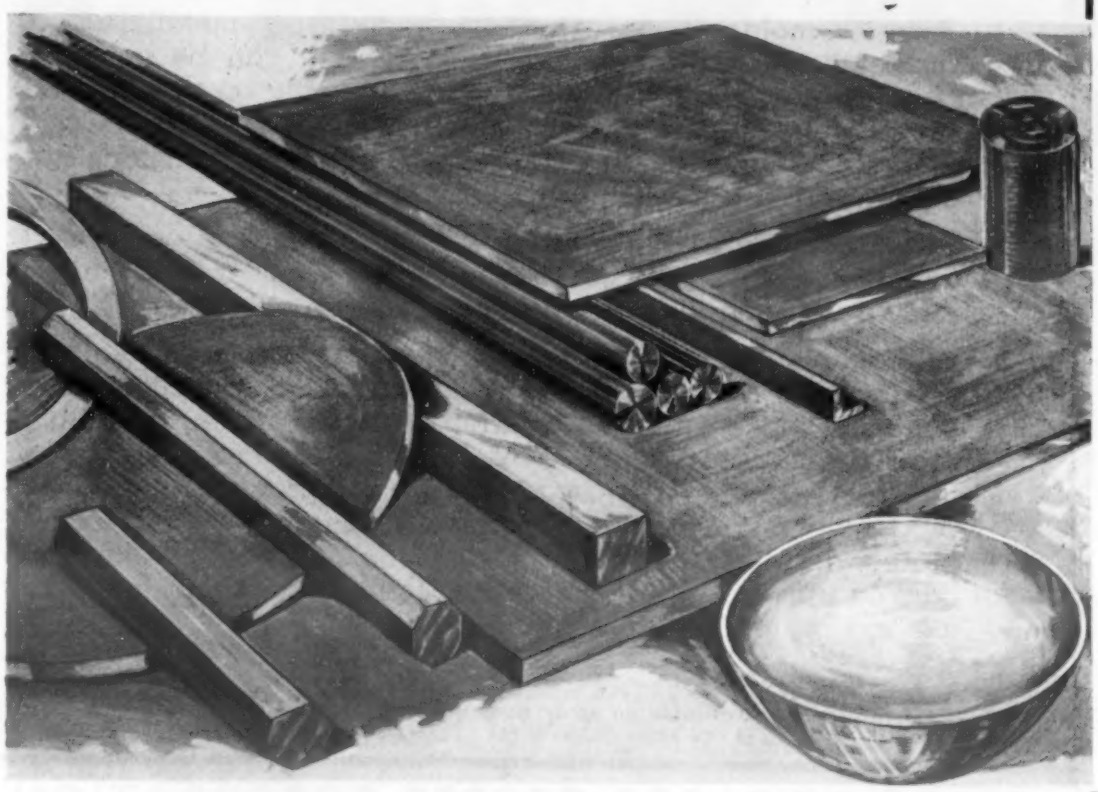

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Do you make plastic molds?

● Cerro alloys are successfully used in making molds for casting plastics. Low temperature setting plastic materials can be cast in molds of Cerrobase 255° F. or Cerrotru 281° F. These molds may be made inexpensively by either spraying or casting.

1. **Sprayed molds**—best for models made of non-metallic materials, where heat conduction is poor. But can be used for metal models also. Alloy is sprayed directly on model. Full information for this process given on request. Since Cerro alloys are non-shrinking, surface detail and dimensions are accurate and no polishing is required.
2. **Direct cast Cerro alloy molds**—models made of good heat conductors are easily reproduced in molds by casting alloy directly against them. Full information on request.
3. **For models with undercuts**—mold can be cast in sections or produced by electroforming. By latter process, difficult surface contours can be molded by first investing model in flexible molding material such as latex. Then flexible mold is stripped from model, supported in plaster and Cerrobase poured in, producing a true metallic positive. This positive is electroplated and the Cerrobase melted out. The mold shell is backed up with suitable material. Full information about this method on request.

•

Information available on spray guns will be furnished on request.

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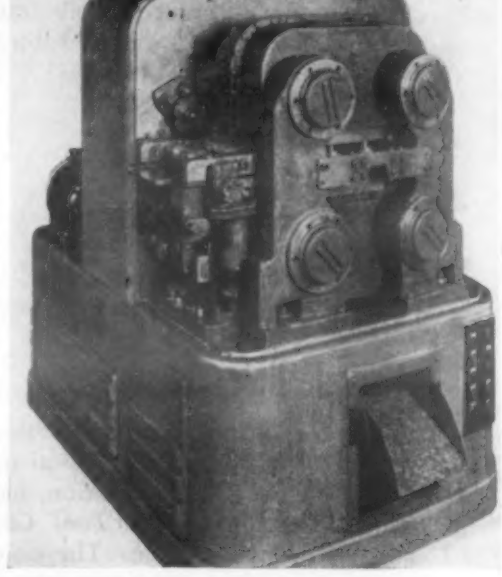
Punch Press Achieves Speeds of 1800 Strokes Per Min.

A new high-speed punch press, known as the Hypermatic, has been announced by *Lempco Products, Inc.*, Bedford, Ohio. The press employs the use of a rotary motion in actuating the dies. Four crankshafts are used; the upper two, rotating clockwise, drive the upper die head while the lower pair of crankshafts, counterclockwise in motion, drive the lower die head.

The die members are mounted between the two die heads, the punch holder being fastened to the upper head and the die holder to the lower die head. The punches and dies, therefore, have the same rotary motions as their respective die heads, closing and opening in each cycle of the crank-



Producing "butterfly" lock washers at rate of 1700 per min. on this new high-speed punch press.

shafts, giving the advantage of cutting the stock while it is actually in horizontal motion (cutting the stock as it goes by).

Speeds ranging up to 1800 strokes per min. are possible. The high velocity results in about 10% cut and 90% break, producing stampings with less burr, distortion and draft than would be ordinarily possible. On the press it is common practice to register the stamping so close together that length of scrap between blanks is less than the thickness of the metal and the metal "stands up" instead of "mushing down" as is customary.

This velocity also reflects itself in die life. The quick, sharp "cut and break" eliminates to a great extent the heat creating friction.

The stroke of the press is adjustable to 45 different positions. The adjustment can be made on all four cranks simultaneously. The locking mechanism is positive; there is no possibility of any of the crank mechanisms to slip out of adjustment.

The feed mechanism of the press is roller type, and feeds stock with precision at the highest operating speeds. The feed roll speeds are synchronous with both press speed and pitch of the part being produced. The maximum in stock feeds is approximately 5600 lineal in. per min.

(Continued on page 143)

on the 10-ton model and 10,000 lineal in. per min. on the 50-ton model.

The feed roll mechanism can be used to feed stock continuously or in cases where pilot pins are used for extreme accuracy (generally, in progressive dies), the rolls may be "cracked" at any point in the cycle so that the stock may be carried through either entirely or in part by the die members themselves. For ease of handling stock for the setup or die tryout, the feed rolls may be "cracked" manually by means of a hand lever.

Powdered Alloy Has Strength and Density Near That of Tungsten

A sintered alloy, known as Mallory 1000 Metal, prepared by powder metallurgy methods, has been developed by *P. R. Mallory & Co., Inc.*, 3029 E. Washington St., Indianapolis, Ind. This metal is said to have strength and a high density approaching that of tungsten. It is resistant to atmospheric corrosion and to certain acids, making it useful as fixtures in electrolytic processes.

Its high modulus of elasticity, ranging from 20,000,000 to 40,000,000 lb. per sq. in., combined with its high density and tensile strength, make it suitable for highly stressed parts such as balancing components and rotors. It is useful in both industrial and medical fields for radium containers. Unlike tungsten, Mallory 1000 Metal is readily machinable.

Press Type Spot and Projection Welders Are Versatile

A new line of improved roller-head, press-type spot and projection welders, ranging from 50 to 500 Kva. capacity has been announced by *Progressive Welder Co.*, 3050 E. Outer Drive, Detroit 12. These new welding machines are equally adapted to continuous high production runs and to handling of various types and sizes of work on a job-lot run basis.

Provision can be made for pulsation welding, resistance-upsetting and resistance-brazing; also for pre-heating, post-heating or tempering of the work while still in the machine.

Much of this versatility probably is due to the new method of frame construction. The frames are actually designed in two sections. The forward section of the frame, which has to take all the high stresses incident to resistance welding with high pressures, is of heavy construction. To this section are attached the head, knee, platens and arms. Welding transformers are also supported from this frame section.

The rear section of the frame, in contrast, is of relatively lightweight construction and is actually a removable sheet

(Continued on page 144)

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Three types: STANDARD for temperatures up to 2400 F; H.T. for temperatures up to 2800 F; L.W. (lightweight, low conductivity) for temperatures up to 2400 F.

FIRECRETE IS QUICKLY OBTAINED FROM YOUR J-M DISTRIBUTOR

In your locality is a J-M Distributor who carries Firecrete. There are 300—strategically located throughout the country to give you quick service. Ask him about Firecrete or write for folder RC-17A to Johns-Manville, Box 290, New York 16, N. Y.

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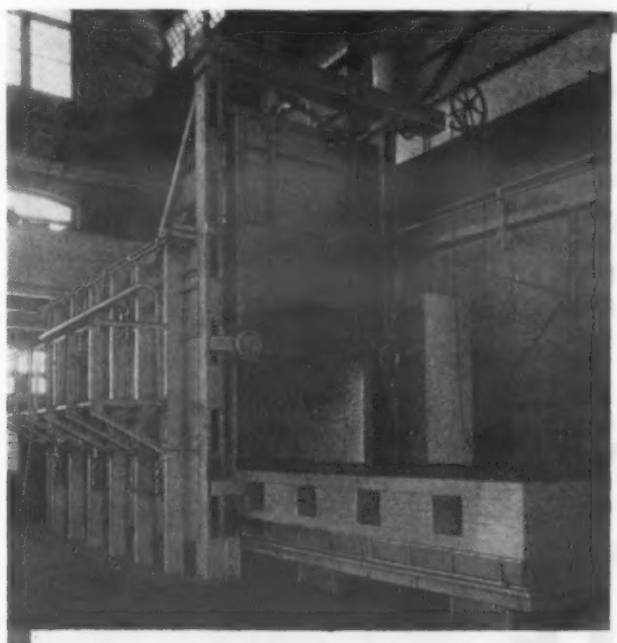

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Dempsey designed over-and-under fired Car Type Furnaces are being repeatedly reordered by satisfied users—proof of their ability to do many critical heat-treating jobs effectively.

This furnace "of many uses"—equipped with precise automatic controls—insures even heat distribution and correct temperatures *within* the work and eliminates warpage and distortion through controlled heating and cooling cycles.

Heat is supplied faster and more uniformly—saving time and producing better results—in heat ranges from 500°F. to 1800°F. and higher. Can be furnished with combination gas and oil burners—avoiding fuel shortage shutdowns.

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Write for Bulletin 3-4, Dept. 2

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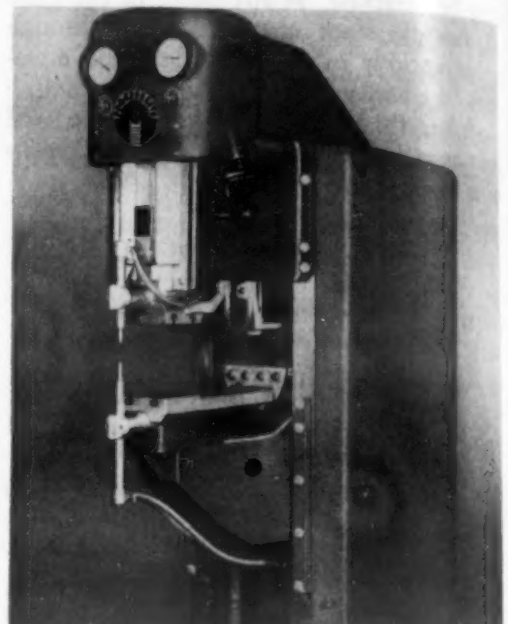
metal enclosure. As a result, the interior of the machine is accessible for any work to be done on controls, electrical connections, etc.

Machine operation is obtained through either air or hydraulic actuation, on all



One of the new line of press type roller head, spot and projection welding machines.

sizes up to 250 Kva. On larger machines, hydraulic operation is standard. All machine sizes are available with throat depths of 18, 24 or 30 in. (projection welding); 18 to 36 in., for spot welding.

The 50- and 75-Kva. machines are offered in two styles: a spot welder and a projection welder. The projection welder type machine is readily convertible for spot welding merely by adding spot welding horns, electrode holders and electrodes. The straight spot welder with its swiveling lower arm is also convertible to projection welding, although this requires the addition of a projection welding type lower knee and upper and lower platens.

Machines ranging from 100 to 250 Kva. are offered as combination machines. On these both projection and spot welding can be performed.

Automatic Shop Furnace of Improved Design

A completely redesigned shop furnace made of fabricated steel instead of castings has been announced by *Eclipse Fuel Engineering Co.*, 746 S. Main St., Rockford, Ill. The unit is fully enclosed and houses all working parts, protecting them against dust and damage and eliminating any possibility of workmen accidentally contacting any of the electrical or mechanical machinery.

The shop furnace is designed to meet the needs of shops requiring a small tool-room furnace for hardening punches, dies and small tools. While designed for carbon and intermediate steels, high-speed steel can be handled satisfactorily.

Although primarily designed for intermittent use, it can be operated continuously with satisfactory results under favorable conditions.

News of...

ENGINEERS COMPANIES SOCIETIES

Engineers

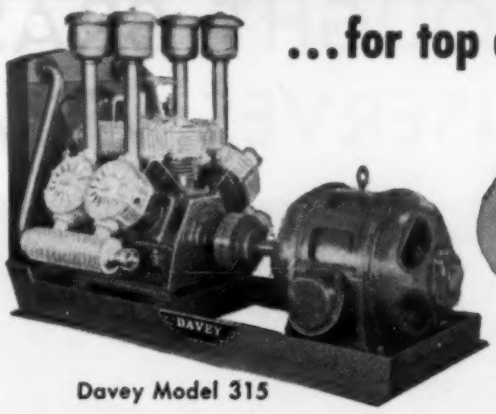
William B. Brooks has established a metallurgical consulting service at 1102 Park Bldg., Pittsburgh 22, after broad experience in stainless and heat resisting steels, materials engineering, industrial corrosion, low alloy constructional steels, welding and radiography of welds and castings. He has been with the Alloys Development Co., other connections having been with Allegheny Steel Corp., Carnegie-Illinois Steel Corp. and Cramp Shipbuilding Co. He belongs to seven technical and social clubs.

Alfred W. Schultz has been made director of production and planning control, Warren City Mfg. Co., Warren, Ohio, maker of fabricated steel frame presses and press brakes. Company connections have been with Cleveland Punch & Shear Works Co., Clearing Machine Corp., Verson Allsteel Press Co. and Midland Machine Co. He belongs to mechanical engineering and tool engineering societies.

Dr. *Wendell F. Hess,* head of the welding laboratory of Rensselaer Polytechnic Institute, has become head of the department of metallurgical engineering at R. P. I., succeeding Dr. Matthew A. Hunter. In the past three years Dr. Hess has received four national prizes for research in metallurgy.

Harry Oldham has been made superintendent, New Brunswick, N. J. foundry, Mack Trucks, Inc., having left foundry positions with Ford Motor Co., some of the time as superintendent, magnesium foundry. His early foundry experience was gained in Scotland and England.

W. C. Snyder, Jr. is now vice president, Engineering and Construction Div., Koppers Co., Inc., succeeding John F. Byrne who was killed May 30 in the Maryland crash of an airplane, with 53 casualties. He has specialized in building of steel mills and associated plants, constructing the first Kaiser rolling mill at Fontana, Calif. and mills in Argentina, Brazil, Sweden, France, Belgium and England.



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- Ease of installation
- Reduced maintenance and replacement expense

IN LINE with today's trend toward employment of small departmental compressors instead of one large centralized machine, Davey offers a complete line of industrial units.

These are available in 60, 105, 160, 210 and 315 c.f.m. capacities. And every Davey has GUARANTEED LIFETIME VALVES.

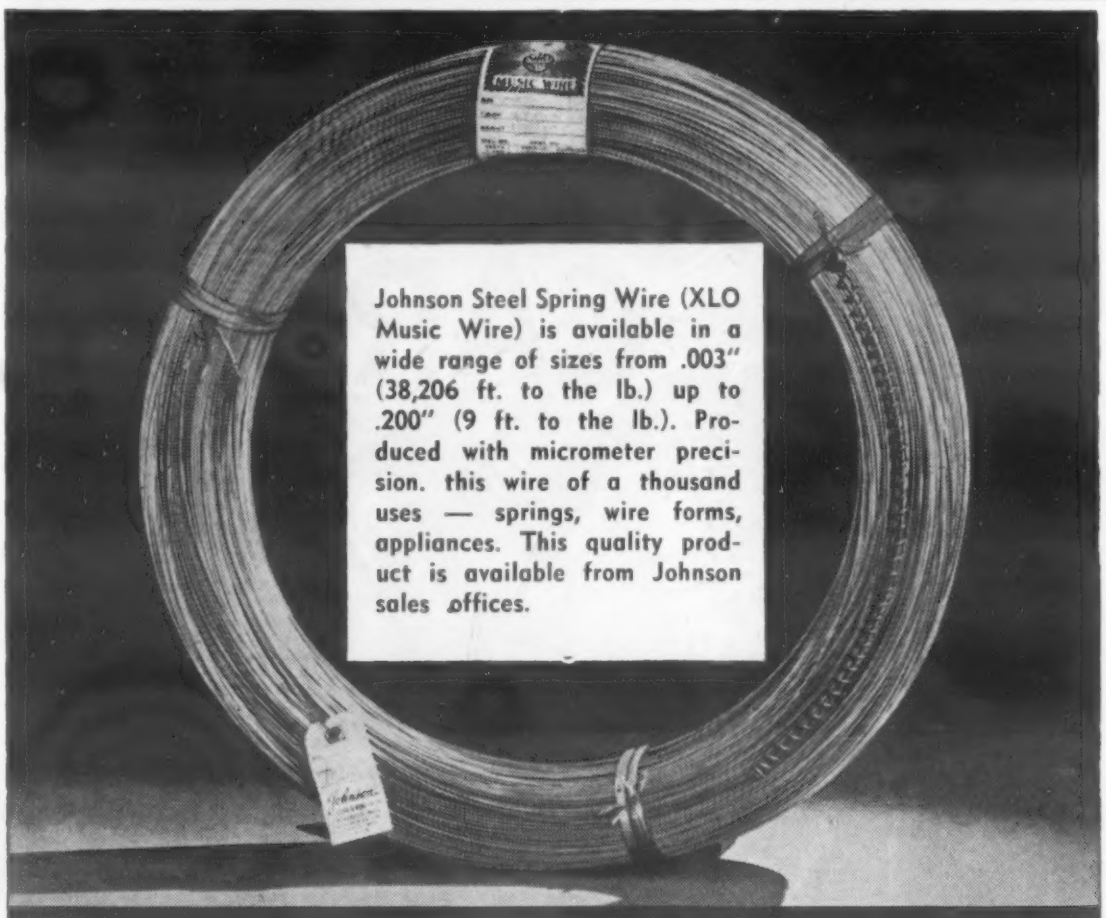
DAVEY COMPRESSOR CO. • KENT, OHIO

Write for Bulletin E-219

DAVEY

P & P-102

DAVEY COMPRESSOR CO. *Dealers in Principal Cities*



Johnson Steel Spring Wire (XLO Music Wire) is available in a wide range of sizes from .003" (38,206 ft. to the lb.) up to .200" (9 ft. to the lb.). Produced with micrometer precision. this wire of a thousand uses — springs, wire forms, appliances. This quality product is available from Johnson sales offices.

JOHNSON

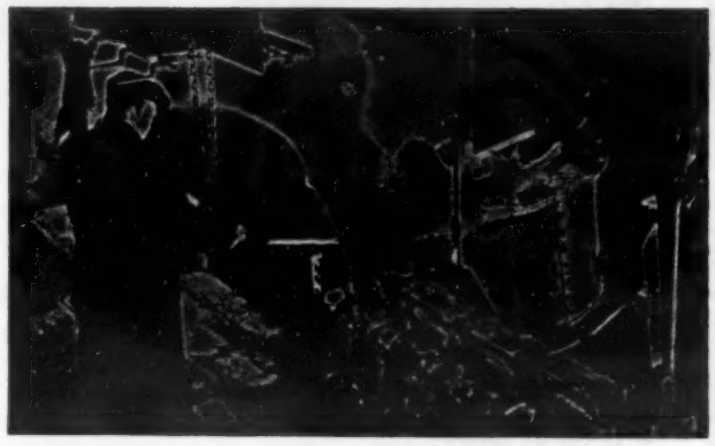
STEEL AND WIRE COMPANY, INC.

WORCESTER 1, MASS.

NEW YORK AKRON DETROIT CHICAGO LOS ANGELES TORONTO

HOW THE WROUGHT BRASS INDUSTRY CONSERVES METAL

No industry melting *commensurate tonnage of vital metal can quite match the brass mills for conservation and low melting losses. The savings of metal total millions of pounds; clearly the method they use is worth noting:**



Virtually all the brass mills in North America use the Ajax-Wyatt induction melting furnace, for it has the lowest metal losses in the field — less than 1% — with superior temperature control and unapproached economy of operation on high production schedules such as we have today.

The accepted melting tool in brass rolling mills throughout the world.

AJAX ELECTRIC FURNACE CORP.
1108 Frankford Avenue
PHILADELPHIA 25, PA.

* UPWARDS OF 5 BILLION POUNDS ANNUALLY

THE AJAX WYATT INDUCTION MELTING FURNACE

ASSOCIATE COMPANIES: AJAX METAL COMPANY, *Non-Ferrous Ingot Metals and Alloys for Foundry Use*
AJAX ELECTROTHERMIC CORPORATION, *Ajax-Northrup High Frequency Induction Furnaces*
AJAX ELECTRIC COMPANY, INC., *The Ajax-Wyatt Electric Salt Bath Furnace*
AJAX ENGINEERING CORPORATION, *Ajax-Tama-Wyatt Aluminum Melting Induction Furnaces*

Master Hands on Intricate Jobs use

SHAWINIGAN CARBIDE

SHAWINIGAN
SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING,
NEW YORK 1, N.Y.

News of...

ENGINEERS COMPANIES SOCIETIES

Randolph J. Roshirt is appointed general manufacturing manager, Bohn Aluminum & Brass Corp., in charge of all 14 plants. He has been closely identified with metallurgy and manufacturing of nonferrous metals for 32 years. Since 1935 he has been in direct charge of all of Bohn's foundry production.

Hugh J. Fraser, vice president, International Nickel Co., Inc., has been placed in charge of all plant operations in the United States. *John A. Marsh,* assistant general manager, Huntington Works, has been made Mr. Fraser's assistant. *Joseph M. Weldon* has been appointed assistant to H. J. French, vice president, having joined International Nickel from Union Carbide & Carbon Corp.'s research laboratory and having been a naval aviator during the war.

Rudolph Furrer has been elected vice president in charge of engineering, American Car & Foundry Co. He served on the War Metallurgy Committee and as a special consultant in ordnance research and development. He has been associated with Allis-Chalmers Mfg. Co., A. O. Smith Corp. and U. S. Steel Corp.

F. L. Ebersole, formerly mechanical engineer, American Rolling Mill Co., has joined Loewy Construction Co., Inc., New York, as assistant chief engineer, Rolling Mill Div. For over 35 years he has been an engineer in the steel industry.

E. D. Spicer has been put in charge of the manufacturing policy of General Electric Co., continuing as a member of the president's staff. He joined G. E. in 1924 and was works manager before becoming a vice president.

Dr. *William E. Good,* Westinghouse physicist, has been granted a year's leave of absence to aid in atomic energy investigation at the Argonne National Laboratory, Chicago. Recently he helped perfect a microwave spectroscope, to serve as a valuable new tool for chemists.

Col. *Leslie S. Fletcher* will serve as technical director for Sam Tour & Co., Inc. and its affiliate, the American Standards Testing Bureau, Inc., New York. In recent years he has been prominent in army ordnance development.

Lloyd W. Hackley is now superinten-

News of...

ENGINEERS
COMPANIES
SOCIETIES

dent, production planning, American Steel & Wire Co., having joined that company in 1937 as industrial engineer at the Consolidated Works in Cleveland.

Leonard R. Scribner has become chief engineer, Tantalum Sales Div., Fansteel Metallurgical Corp. He did graduate work at the University of Illinois in the research group in rare metals and earths.

Louis Walter Kempf, assistant director of research, Aluminum Co. of America, died in Cleveland, June 14, after an extended illness. He had achieved international recognition as a scientist, author and inventor during his 23 years with Alcoa, which he joined as a research metallurgist. He invented numerous aluminum alloys and was author of many technical papers now regarded as standard references. He had several hobbies, including English literature, amateur photography and classical music.

Companies

SKF Industries, Inc. has launched a two-year modernization and expansion program, involving over $4,000,000 to equip its two Philadelphia plants with new machinery capable sometimes of operating from two to six times faster for bearings manufacture. Thus, one can now cold form rollers for spherical bearings that eliminates turning operations.

Carnegie-Illinois Steel Corp. has taken in 300 undergraduates from scores of colleges for summer training, thus reducing from five to three years the practical training period to become full-fledged engineers after graduation. The money they earn with Carnegie will help them defray college expenses.

Three informative and entertaining movies on magnesium have been released by *Dow Chemical Co.*: "The Working of Magnesium," "This is Magnesium," and "Treasure from the Sea," all being 16-mm. films. They are obtainable on a free loan basis from M. J. Hooker, Advertising Dept., Dow Chemical Co., Midland, Mich.

An independent agency for sampling, testing and certifying of materials has been organized as the *American Standards Testing Bureau, Inc.,* 44 Trinity Place, New York. It has been

SPEED UP SHEET HANDLING

WITH SAFETY FOR MEN AND MATERIALS

Not only do C-F Sheet Lifters make full 3-dimensional (side, end and head room) use of storage room possible, they handle any sheet stock in loading, carrying and unloading operations faster and easier with safety for men and materials. C-F Lifters can handle loose or bundled stock in and out of storage in closer quarters because one man end or remote cab control of Lifter is out of the way. Only minimum space between sheet piles is necessary for Lifter carrying angles to move in.

Long carrying angles give full protection to sheet edges and tong action of lifter arms prevents sheets from slipping or sliding. Sliding lock bar (optional equipment) quickly adjusts legs to accommodate different stock widths.

C-F Lifters are available in capacities from 2 to 60 tons or larger to meet your requirements.

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INVESTING?
The **KERR VACUMATIC**
is your answer!

★

. . . the solution to the bottleneck created by old-style, low-vacuum pumps. This unit will evacuate a bell jar 8" x 5" in about five seconds! — to a vacuum of 29.6". (about 3 times as high a vacuum as 29.0").

The "Vacumatic" consists of a motor (¾ to 2 hp.), Nitralloy pump, and piping and valving details, all efficiently mounted in an attractive black and grey steel cabinet. The 18" x 18" joggle plate will accommodate bell jars up to 16" in diameter.

Available with either one or two vacuum stations, A.C. or D.C., in any desired line voltage.

See the **KERR VACUMATIC** in our new catalog "Precision Casting by the Lost Wax Process" — 32 pages of information, equipment and "know-how". Send for your *FREE* copy today!

★ **I. SHOR**
EST. 1918

Precision Casting Sales and Engineering
64 W. 48th St. • New York 19
Dept. M.

"SOLVOL increased carbide drill life more than 150%..."

...says J. P. TOMLINSON D. A. Stuart Oil Co. Representative

this is the story...

"Using a competitive soluble oil, this manufacturer was getting from twenty to twenty-five holes per carbide drill, being used on angular crankshaft oil holes. The drills in many cases were seizing and flaking as they became dull. Production rate was very slow and cost per crankshaft much higher than they had anticipated. SOLVOL LIQUID CUTTING COMPOUND was put on the job at a twenty to one dilution. Drill life immediately increased to sixty-five holes per drill. Flaking was eliminated entirely. The production rate accordingly increased with reduction of crankshaft machining costs."

J. P. Tomlinson

This actual performance report from Stuart's files provides additional proof that the *right* cutting fluid can make the difference between profit and loss on many metal-cutting operations. Put an experienced Stuart engineer to work on *your* cutting problems... his service, supported by complete specialized laboratory facilities, is available for the asking.

STUART *service goes with every barrel*

WRITE FOR DETAILS

D. A. Stuart Oil Co. EST. 1865 LIMITED

2745 SOUTH TROY STREET, CHICAGO 23, ILL.

News of...

ENGINEERS COMPANIES SOCIETIES

organized to permit expansion of the testing and quality control services formerly rendered by Sam Tour & Co., Inc.

The *York Electro-Cast Corp.*, maker of pure copper castings produced electrolytically, will move into a newly purchased plant at Spry, Pa. in August. The company claims its process permits reproduction of the finest detail in pure copper.

The *Cressell Stainless Steel Co.*, 333 N. Michigan Ave., Chicago 1, has been formed as a sales service engineering company to handle stainless steel in all forms. It is headed by Edward G. Cressell, who has in the past been connected with three stainless steel manufacturers.

Federated Metals Div., American Smelting & Refining Co., has been licensed to manufacture and sell "Everdur," a silicon bronze alloy originally produced by the American Brass Co.

The *Youngstown Sheet & Tube Co.* has been licensed to manufacture "Hi-Steel," a low alloy structural steel, by the Inland Steel Co.

A compressed handbook and guide, "Nickel and High Nickel Alloys," is being distributed by the *International Nickel Co.*, 67 Wall St., New York 5. Written by Dr. Norman E. Woldman, consulting metallurgical engineer, it originally appeared in MATERIALS & METHODS and is now available in reprint form.

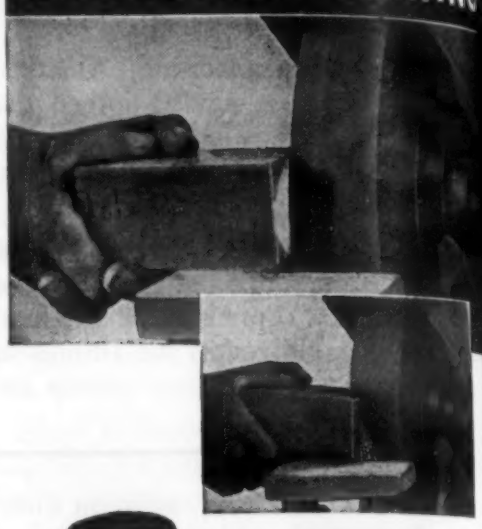
The *Pittsburgh Steel Co.* has acquired the *Johnson Steel & Wire Co., Inc.*, Worcester, Mass., maker of high carbon wire for the automobile, rubber tire, textile and musical instrument industries.

Air Reduction Sales Co. has added another oxygen manufacturing plant at Baton Rouge, La., at which the superintendent is J. L. West, with the company a quarter century.

The *Hunter Pressed Steel Co.*, Lansdale, Pa., maker of precision springs, has inaugurated a new service to customers in the form of a "QR" or quality report by mail on an order immediately after final inspection. The report presents information most needed and in a way most easily understood, being in the form of a frequency distribution of the test load values.

The *Charles L. Jarvis Co.*, Middletown, Conn. has acquired the *Dowding*

BRICKSEAL REFRACTORY COATING

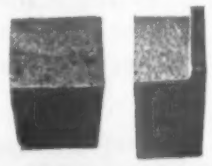


Resists ABRASION

PROTECTION against abrasion is an outstanding advantage of Brickseal. Here are two refractory bricks, one coated with Brickseal, the other uncoated. They were heated to more than 2000°, taken directly from the furnace, cooled and shoved against an emery wheel. Hot and cold, the Brickseal-treated brick resisted the abrasion – see below.

Brickseal consists of high fusion clays and metal oxides combined in oil. Furnace heat burns away the oils and vitrifies the clays and metals which penetrate deeply into the pores, cracks and joints. Brickseal prevents cracking, spalling and slagging regardless of sudden temperature changes. Brickseal is also a mortar for laying up refractory walls.

Compare the Brickseal-treated brick at the left to the untreated at the right.



TRY IT YOURSELF on your emery wheel

Two bricks bonded together and partially coated with Brickseal will be mailed to you on request.

BRICKSEAL REFRACTORY COATING

5800 So. Hoover St., Los Angeles, Calif.

1029 Clinton St., Hoboken, New Jersey

Low-Cost Deoxidizing of Aluminum and Brass

SHOPS using the Oakite Compound No. 34 treatment are finding it a cost-cutting, time-saving answer to the problem of surface conditioning of non-alclad and copper-bearing aluminum alloys.

OAKITE COMPOUND No. 34

. . . is a scientifically formulated acid material. It may be used successfully in connection with such shop practices as:—

Deoxidizing aluminum before spot welding or anodizing

Removing oxide from brass

Producing smut-free, etched surfaces prior to painting

Oakite Compound No. 34 should fit profitably into your production picture. An easy way to find out is to call your nearby Oakite Technical Service Representative. He'll be glad to make test runs in your shop. Oakite formula-fitting service is FREE. Drop a card to address below today.

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News of...

ENGINEERS COMPANIES SOCIETIES

Div., Henry L. Hanson Co., N. Attleboro, Mass., the latter company specializing in engineering and finishing taps and dies.

The *Pittsburgh Works, Allis-Chalmers Mfg. Co.* will experience a construction and expansion program costing several million dollars. A new building will be devoted largely to the production of transformers.

A. F. Davis, *Lincoln Electric Co.,* announces two prizes to best student authors on welding. John W. Price, Jr., Rose Polytechnic Institute, wins $200 for an article on "Atomic-Hydrogen Arc Welding," while Howard Sanders, Cornell University, won $150 on "Welders in Diving Suits."

The *Carborundum Co.* has started construction of its first major building in its $15,000,000 expansion program. This will be known as a Maintenance building.

Lupomatic Industries, Inc. has been organized to take over the operations of the former *Lupomatic Tumbling Machine Co., Inc.,* offices and plant to remain at 4501 Bullard Ave., the Bronx, New York.

Eastern Brass & Copper Co., Inc., warehouser and processor of quality metals, has transferred warehouse and executive offices to their own building at 1122 E. 180th St., New York, thus quadrupling their space.

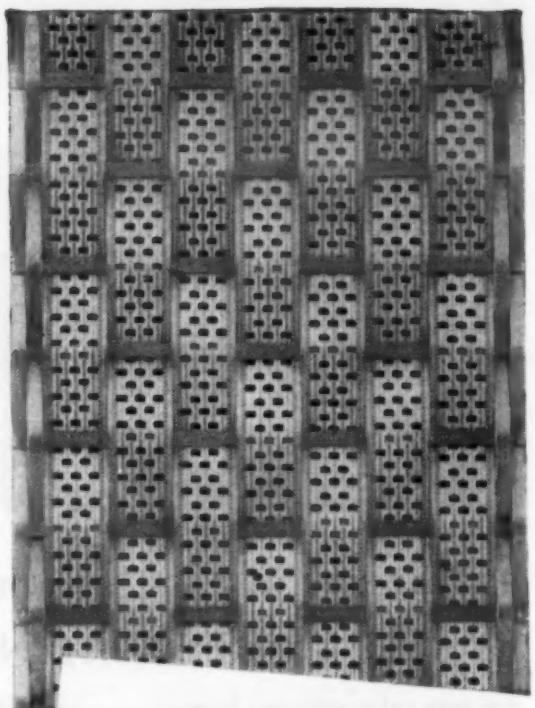
The *Meehanite Metal Corp.,* New Rochelle, N. Y., has licensed the Builders Iron Foundry, Providence, to make Meehanite castings.

Officials and engineers of the *Pittsburgh Steel Foundry Corp.* have been surveying the possibilities of building a steel mill in Argentina. The company promises ability to build a steel rolling mill there which will be producing 18 months after start of construction.

A new branch plant of the *Timken Roller Bearing Co.* has been opened in St. Thomas, Ontario, construction having been started May 15, 1945.

More than $255,000 has been awarded by *General Electric Co.* in scholarships and loans for educational purposes since the program started in 1922.

Campion Laboratories Div., Campion-Detroit, specialist in measuring and control work, has purchased a new building at 9212 Central Ave., Detroit 4.



THIS IS GE MULTI-WEAVE!

—a new product of woven metal with new possibilities for architects and product designers. Combining strength, beauty and durability, it is extremely flexible and versatile in application.

For complete information, write: *General Electric Co., Electronics Department, Syracuse 1, New York*

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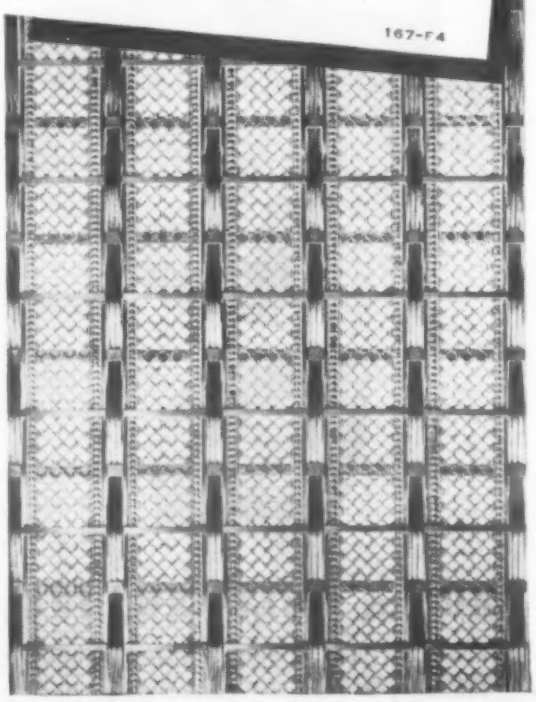

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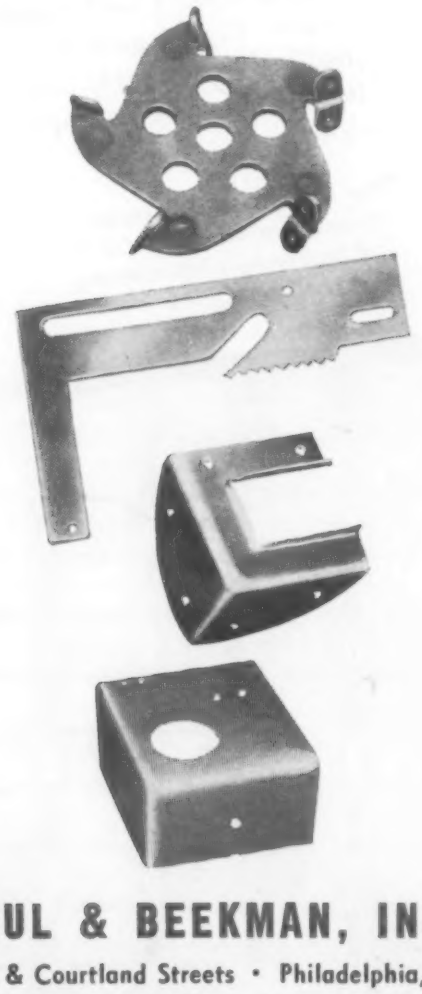
Are your sales suffering because your product weighs too much? Is your capacity limited because of the manufacturing process involved? Are your production expenses up because of high material costs? . . . Any or all of these problems *might* be solved by using the right metal stamping where you're now using another type of construction.

Paul and Beekman, Inc. *knows* metal stampings. We produce them in all types—from mild steel, stainless, copper, aluminum and brass. We make them fast and we make them right, because we have the plant, the personnel and the organization to do just that.

If you think the use of precision stampings might enable you to put out a better product, faster, at less cost . . . call on Paul and Beekman, Inc. Write us for literature explaining our complete service.



PAUL & BEEKMAN, INC.

18th & Courtland Streets • Philadelphia, Pa.

Subsidiary of Portable Products Corporation

News of...

ENGINEERS
COMPANIES
SOCIETIES

Societies

A new electrical product group of 11 companies making apparatus for induction and dielectric heating is announced by the *National Electrical Manufacturers' Assn.* It is known as the Induction and Dielectric Heating Apparatus Section, the chairman being Dr. H. B. Osborn, Jr., sales manager, Tocco Div., Ohio Crankshaft Co.

The *American Electroplaters' Society* announces establishment of a new research project on the disposal of plating room wastes. After study of existing literature, there will follow laboratory and pilot plant investigations and cooperative work in industrial treatment plants.

Preparation of standard specifications for cold-drawn steels has been undertaken by a new division, XVII, Cold-Drawn Steels, of the *Society of Automotive Engineers* iron and steel technical committee. The end in view will be betterment of such parts as studs, bolts, shafts, pinions, axle tubes, frame supports and shackle pins. The chairman is Howard M. Smith, Wyckoff Steel Co.

The *National Assn. of Relay Manufacturers* has just been formed, the first goal being to establish a code of standards by which electrical relays may be tested and rated. The president is Ralph T. Brengle, Potter & Brumfield Sales Co., Chicago.

The *Electric Metal Makers Guild, Inc.,* has elected officers as follows: President, R. H. Frank, Bonney Floyd Co., Columbus; vice president, A. J. Scheid, Jr., Columbia Tool Steel Co., Chicago Heights; secretary-treasurer, D. L. Clark, Simonds Saw & Steel Co., Lockport, N. Y.

Francis B. Foley, Philadelphia metallurgical research head, has been nominated president, *American Society for Metals,* which is tantamount to election when the society meets in Chicago in October. He is at present national vice president of the ASM.

The *Instrument Society of America* will hold its second instrument conference and exhibit at the Stevens Hotel, Chicago, Sept. 8 to 12, and has extended invitations to engineers of all countries to attend. Interpreters and informative service facilities will be provided. A special luncheon will be tendered foreigners Sept. 10.

Raymond B. Tripp, executive vice president, Ohio Forge & Machine Corp., has been elected president of the *Drop Forging Assn.*

The *Malleable Founders Society* has elected as president Wilson H. Moriarty, National Malleable & Steel Castings Co. The society awarded its Charles H. McCrea medal to George E. Bean, managing director, Wilmington, Del. Works, Eastern Malleable Iron Co., for his work on the handbook, "American Malleable Iron."

The *American Society for Testing Materials* has elected as president T. A. Boyd, head, fuel department, Research Laboratory Div., General Motors Corp.

The *American Institute of Physics* has appointed as its assistant director Cleveland Norcross, formerly executive secretary of the Office of Scientific Research and Development. He is filling a newly-created post. The Institute has 9000 individual members.

The *Industrial Furnace Mfgrs. Assn.,* with 45 members, elected as president William Adam, Jr., Ajax Electric Co., Inc., at their recent annual meeting at Hot Springs, Va. He succeeds C. F. Olmstead, Lee Wilson Engineering Co., Inc., who continues as director. Other directors elected were: One year term, J. J. Walker, C. I. Hayes, Inc.; J. Earl Frazier, Frazier-Simplex, Inc., and F. W. Brooke, Swindell-Dressler Corp.—for two years, R. T. Cadwell, Holcroft & Co.; W. E. Borbonus, R-S Products Corp., and S. W. Fletcher, J. O. Ross Engineering Corp.

Meetings and Expositions

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, bi-monthly meeting. San Diego, Calif. Aug. 26-29, 1947.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting. Salt Lake City, Utah. Sept. 1-4, 1947.

INSTRUMENT SOCIETY OF AMERICA, conference and exhibit. Chicago, Ill. Sept. 8-12, 1947.

PORCELAIN ENAMEL INSTITUTE, annual forum. Columbus, Ohio. Sept. 10-12, 1947.

NATIONAL PETROLEUM ASSOCIATION, annual meeting. Atlantic City, N. J. Sept. 17-19, 1947.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION, Machine Tool Show. Chicago, Ill. Sept. 17-26, 1947.

ASSOCIATION OF IRON & STEEL ENGINEERS, annual meeting. Pittsburgh, Pa. Sept. 22-25, 1947.

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The Last WORD

by T. C. DU MOND

No Pork on These Pigs

Perhaps you, as we, have often wondered why the term "Pig" was applied to a piece of iron or other metal. The name comes from an old method of making iron whereby the liquid metal was run from the furnace into a sand-lined runner that fed into a number of smaller troughs where the iron cooled and hardened. Someone likened this to a sow and her suckling pigs, thus the name. This fact was gleaned from *Steel Horizons,* the AISI publication.

Straw in the Wind?

Here is something we have been preaching right along. A redesign of existing products to take advantage of better materials and methods of processing them has made possible reductions in price of from 5 to 25% in conveying equipment. The achievement was made by Island Equipment Corp., New York, on some equipment, leading to a plan to reexamine and redesign every item in its line to carry the program to its logical conclusion.

Every Dog Has Its Day

We hope that labor takes enough time to perfect a change in attitude so that by the time September 20 rolls around it will not mar the idealistic aims of American Management Day. Sponsored by the National Association of Foremen, the special day is to be the final event of the convention of the Foremen's group. It would seem that it is about time good management at least had a day named for it. Days and even weeks have been named for much less worthy groups and less lofty purposes. If this thing takes hold and attains the same stature as Labor Day, we can look forward to another holiday. This year's celebration is being staged in Los Angeles.

Drawing Things Pretty Fine

We can sympathize with the man who writes the *Ohmite News.* He once mentioned that the smallest tungsten wire ever drawn had a diameter of 0.00018 in. and that it could not be seen without magnification. Within a few days he was brought up short when the mail delivered him mounted samples of wires having diameters of 0.00016, 0.00035 and 0.00001 in., respectively. The fact that added insult to injury was that even the smallest wire could be seen with the unaided eye, under proper light. The wires shown were samples of the types used in fuse manufacture and are handled every day.

Inert Arc Welding of Nickel

In our April issue we ran an article on the use of Inert Gas Shielded Arc Welding. One point in the article was somewhat in error, we are advised by Mr. K. M. Spicer of the International Nickel Co. Mr. Spicer points out that at the present time Monel and pure nickel are not welded in too satisfactory a manner by this process. It seems that these two materials are not joined with sound, pore-free welds. Therefore, inert arc welding is not generally recommended. The reason being that Monel and pure nickel are usually applied where corrosive media are to be handled, and the porosity might lead to premature failure. This particular problem is now being investigated in Inco Laboratories and there is high hope that methods can be worked out so the Heliarc process can be recommended without qualification in the very near future. The problem is now near solution with Monel through a slight change in melting practice.

Casting Bread Upon the Waters

A preview of practices which may become general among producers of industrial equipment is given by a recent news release on behalf of Lester-Phoenix, Inc., producers of molding equipment for plastics. Realizing that the only time molding machinery can be sold is when producers of molded plastic parts are kept busy, Lester-Phoenix is going to promote the advantages of such parts. The basic philosophy is that those who supply an industry with equipment or materials should do all in their power to promote that industry. In that way all segments of the said industry can prosper together. Materials manufacturers have worked this way in the past, but it is not often that machine manufacturers publicize and promote the use of products their machines work on.

What Is an Engineer?

Recently we saw a definition of an engineer which we will publish without any additional comment pro or con: "An Engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulae calculated with micromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopeless chimerical group of fanatics referred to all too frequently as Engineers."

On second thought, we will say the description could be improved by the judicious insertion of a few periods.

Ignition of Magnesium Alloys

One of the authors of the July article on the ignition of magnesium alloys during heat treatment—C. B. Willmore—wants to point out that a false impression might be obtained due to an omission in the article. This point concerns the effect of organic matter. Organic matter appears harmless when heated slowly with the furnace load. But when organic matter such as oil contacted magnesium sheet when the temperature of the sheet exceeded the autogenous ignition temperature of the organic matter, then the latter produced a flame which ignited small magnesium slivers from whence the fire spread to the entire load. Oil dripping from a fan or any other source could cause such a fire, and such causes of fires cannot be considered remote.

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